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Dual Effort

In the daily Press there have appeared reports from which it would seem that better material progress in the foundry industry would be made by paying greater attention to provisions of the Garrett Report than by following the precepts enunciated by the Report of the Steel Founders Productivity Team. To our mind, the discussion resembles the age-old problem of "which came first—the egg or the chicken?" Surely, in the final analysis, the two objectives are the same, that is, the orientation of the industry into one of which everybody can be proud. The foundry industry always has been and always will be of a very complex and divergent character.

The location of the foundries in large cities, in modernised towns, in "garden cities," or in villages presents differing problems. They employ, individually, staffs ranging from thousands to one man and a boy. Some are highly mechanised, whilst others are almost "rural-craft" shops. Under these conditions, it is not surprising to learn that the mentality of the people in the industry is of an equally varied nature. Thus, at one large works where bathing facilities were instituted but a few years ago, such has been their popularity that additional accommodation is now being provided. At a second works, however, excellent modern washing facilities are being completely neglected and men are using the canteen without even ridding themselves of the foundry dirt. We should be happier if so many reports did not reach us of the abuse of facilities provided. It is apparent that in certain areas much remains to be done to teach respect of private and communal property. However, it is incumbent upon all of us to persevere. Maybe, the discovery of some psychological approach may alleviate if not entirely eradicate this disgraceful situation. Would "mucky hands are better than a dirty conscience" have any effect in checking this vandalism?

We fail entirely to see why production and provision of amenities should not go hand in hand. Mechanisation does not necessarily make for an increased dust content in the works atmosphere. In the most recently erected high-production foundry, no less than one-third of the huge total of horsepower available is being devoted to dust reduction, ventilation and other amenities. It is truthful to say that to-day no major scheme of mechanisation would be envisaged without serious attention being given to the institution of proper hygienic working conditions. The smaller foundries are in a number of cases doing their best. One instance coming to mind is a foundry employing twenty men. It has provided each man with a locker, excellent washing facilities and a well-furnished, homely rest room. If he thought the provision of food-warming apparatus would be appreciated, the owner would install it, but at the moment he is not convinced. The shops are clean and tidy, and properly heated and ventilated. That at least is a good start. Still, all this does not solve the major problem ahead of us, which is we must produce more goods at a price at which they can be sold on the international market in order that we can import the necessary food and raw materials to regain and maintain a reasonable standard of living. Finally, we claim that, since the inception of the JOURNAL, its policy has been invariably one of lending the fullest support to any endeavour designed to make the foundry a better place in which to work, and it is to us, quite pleasing to find that, belatedly in some cases, all sections of the industry are now adding their support.

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Festival of Britain

The Festival of Britain, to be held from May to September, 1951, is intended as a nation-wide demonstration of Britain's achievements in the arts, sciences, technology, and industrial design. The south bank of the Thames in London has been a hive of activity for some months, as this is to be the site for the main exhibition. Three other supplementary exhibitions, two in London and one in Glasgow, will deal in more detail with architecture, science and heavy engineering respectively.

The main sections may be summarised as follows:—The Land of Britain—country (wild life, agriculture, forestry); natural resources (coal, iron, limestone, etc.); power and production; sea and ships; transport and telecommunications; the British People; character and tradition; television, health and sport. British contributions in the making of iron and steel will be displayed in the "National Resources" section. Due recognition will be given to the notable contributors in the past and scenes of contemporary iron and steel making will be shown. Aspects in the latter field to be particularly displayed are nodular cast iron, steels designed for particular purposes, and a survey of light alloys and copper alloys and their uses. In the "Power and Production" section there is a "Gallery of Metals'" showing typical British metal-handling practice with its attendant scientific control from ingot to sheet, rod, rail, etc., and a small section on the casting of metals. To illustrate the contribution of metallurgical research to industry, a laboratory will show some of the work entailed in solving a particular problem, *e.g.*, the development of the high-strength magnesium-zirconium alloys. Decorative and wear-resistant metallic coatings and chemical coatings on metals will also be displayed. The "Transport" pavilion carries the story of the development of the temperature-resistant alloys for jet engines, turbine blades, etc. Corrosion-resistant alloys and coatings are shown in "Sea and Ships."

Concurrently, there will be an exhibition of Science at the famous South Kensington museum. Entry to this will be through a series of chambers in which ordinary objects are successively magnified until the spectator, narrowing on a single crystal, can see the atoms which compose it. The latest results of current research will be shown—applications, of products from the atomic pile, study of cosmic rays, fabrication of entirely new dyes, drugs and plastics, and the most recent metallurgical developments. Some of the learned societies and institutions are initiating special sessions or otherwise modifying their 1951 programmes to contribute to the Festival theme in their own chosen fields. The British Association, for example, will be meeting in Edinburgh in 1951, with H.R.H. The Duke of Edinburgh as President, while the Institutions of Civil, Electrical and Mechanical Engineers are jointly arranging a ten-day conference.

Dinner

North Staffordshire Ironfounders' Association

The ninth annual dinner of the North Staffordshire Ironfounders' Association was held last week at Ash Hall Hotel, Stoke-on-Trent, Mr. J. S. Goodwin presiding. Mr. V. C. Faulkner, Editor of the FOUNDRY TRADE JOURNAL, was the guest of the evening. Amongst those present were Mr. E. Barrance, Mr. E. Breeze, Mr. W. T. Laverton, Mr. J. Johnson and Mr. E. Pepper. The function was organised by Mr. E. Pepper, secretary of the Association.

Forthcoming Events

MARCH 14.

Institution of Chemical Engineers.

Research Papers from Imperial College and University College, London, and the University of Birmingham, at the Geological Society, Burlington House, Piccadilly, London, W.1, at 5.30 p.m.

MARCH 15.

Institute of Vitreous Enamellers.

Northern Section:—"The Application and Functions of the Soluble Silicates in Modern Metal Cleaning," by T. H. Hilton, at the Queens Hotel, Manchester, at 7 p.m.

Chemical Engineering Group.

Newcastle-upon-Tyne Section:—Joint Meeting with the Society of Chemical Industry. "Recent Advances in Lubrication Practice," by Dr. H. E. Priston, at the New Chemistry Department, Kings College, Newcastle-upon-Tyne, at 6.30 p.m.

Institute of Fuel.

Yorkshire Section:—"Recent Developments in High-temperature Refractories," by A. E. Dodd, M.Sc., at the University, Leeds, at 2.30 p.m.

Institution of Production Engineers.

Liverpool Section:—"Methods of Protection against Metallic Corrosion," by T. A. Evans, F.R.I.C., at Radiant House, Bold Street, Liverpool, at 7.15 p.m.

Manchester Section:—"Advance in Industrial Heat-treatment," by J. McHenry, A.M.I.F., A.M.I.T., at the Mechanics Institute, Crewe, at 7.15 p.m.

MARCH 17.

Coventry Section:—"Some Notable Aluminium-alloy Castings," by A. R. Martin, at the Greyfriars Rooms, The Geisha Café, Hertford Street, Coventry, at 7 p.m.

MARCH 18.

Institute of British Foundrymen.

Bristol and West of England Branch:—Short Paper Prize Scheme, at the Grand Hotel, Broad Street, Bristol, at 3 p.m.

THE GENERAL IRONFOUNDERS' PRODUCTIVITY TEAM are scheduled to arrive to-day at Southampton in the Queen Mary.

MR. STANLEY N. EVANS, M.P., the well-known Birmingham foundry sand merchant, has been appointed Parliamentary Secretary to the Ministry of Food.

THE DEATH OCCURRED recently of Mr. E. B. Muscroft, who was on the staff of the British Iron & Steel Corporation, Limited. Mr. Muscroft, who was 63 years of age, was a well-known and highly respected personality in the iron and steel industry. He commenced his business career with Thos. W. Ward, Limited, at Sheffield, in 1900, and in 1923 took over control of the company's scrap-iron and steel interests in South Wales. In 1937 he undertook special duties with the British Iron & Steel Corporation, Limited, in connection with scrap supplies to the steel industry, which brought him into close contact with both the consuming and supply sides, and he remained very active in this connection until his death.

W. A. TURNER, JEFFREY & COMPANY, 44, London Road, Royston, Herts, announce that, as from March 1, the partnership will be increased by a third member, Mr. E. P. Peregrine, B.Sc., Mem.A.S.M.E., A.M.I.C.E., A.M.I.Mech.E., A.M.I.E.E. Apart from having just completed four years as chief research engineer to the Parsons and Marine Engineering Turbine Research and Development Association, Mr. Peregrine has had wide experience in the field of advanced mechanical and electrical design, with particular reference to steam and gas turbines for marine and aircraft propulsion, hydraulic and gear transmission systems, electric motors and power-house equipment, hydro- and aero-dynamics and combustion and refractories. In consequence of this change, the future style and title of the partnership will be as follows:—Peregrine & Partners, incorporating W. A. Turner, Jeffrey & Company.

Nodular Cast Iron*

By G. Vennerholm, H. Bogart, and R. Melmoth

This Paper is a realistic evaluation of the present state of development of nodular cast iron. It includes methods of manufacture, effect of composition on physical properties, and economic factors involved. A range of potential applications is discussed and there is finally a note on present-day limitations. The Authors are on the staff of the Ford Motor Company, Dearborn, Michigan.

Introduction

THE importance of castable ferrous alloys in the over-all picture of motor vehicle and allied manufactures is best shown by their extensive application in the modern vehicle. Because of their ability to take the shape of practically any moulded cavity, these alloys not only permit great freedom in design, but also possess certain important inherent physical characteristics not present in the forgeable alloys. This is particularly the case with grey cast iron, where the presence of free graphite flakes in a steel-like matrix results in high resistance to mechanical wear and heat-checking, excellent damping qualities, superior machinability, etc. These properties, depending upon the discontinuity of structure produced by the graphite particles, are achieved, however, at a sacrifice of strength and ductility, thereby limiting applications of this material to relatively low-stressed parts. Similarly, in malleable iron, the presence of free graphite, although of a different type, results in certain peculiar properties such as excellent machinability, etc. As the matrices of both cast iron and malleable iron are of the same nature as steel whether it be ferritic, pearlitic, martensitic, or austenitic, the degree to which free graphite affects the properties depends largely upon the size, shape, and distribution of the graphite particles.

The greater the structural discontinuity produced by large, flaky graphite, the more pronounced is the adverse effect on strength and ductility. Obviously, the smallest loss in physical properties will result from a graphite that is present in a finely-dispersed, well-rounded particle.

Up to very recently, the control of the graphite formation in cast iron in the as-cast condition was, as a general rule, rather limited. It is true that by careful control of the metallurgical process and the utilisation of various so-called inoculants, the distribution and size of the graphite can be fairly well governed, but the shape in most instances still remained that of a flake. By adjusting the composition and cooling rate in such a manner that all the carbon remains in the combined form upon solidification of the metal and later is precipitated by means of thermal treatment, as in the case of malleable iron and various types of graphitic steels, it has been possible to produce rounded graphite particles. These particles, however, upon high magnification often reveal themselves to be an aggregate of very fine graphite flakes.

In view of this, it is of significant interest to both the engineer and metallurgist that research conducted both in this country and abroad, has now resulted in ways and means of producing a rounded graphite particle in the as-cast metal. Furthermore, this graphite particle does not seem to be an aggregate of fine flakes, but a true carbon crystal body or "spherulite." Although the information generally available so far is rather limited, indications are that these irons have a wide range of potential engineering applications. In order, therefore, to make proper use of this material, it behoves those in the motor-vehicle industry to keep in close touch with the progress made in its manufacture and application.

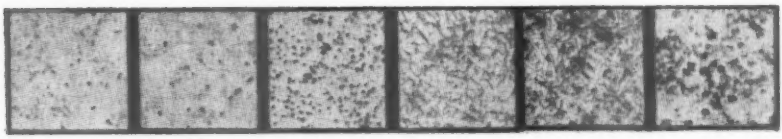
It is proposed, for the sake of simplicity, to refer to this material as "nodular-graphite iron" as distinguished from "flake-graphite iron," or for short, "nodular iron." As relatively few opportunities have presented themselves to compare notes with other investigators, most of the data in the following summary of the factors involved in the making of nodular irons and their commercial development are, of necessity, based on results obtained in the Author's research laboratories and foundries. Furthermore, personal investigations have been directed towards specific application, and as a result may not have covered the field as broadly as would be desirable.

Effect of Graphite Type on Mechanical Properties

Perhaps the best way to demonstrate the importance of the shape of the graphite particle as it affects the resultant mechanical properties and to show how nodular iron fits into the picture of engineering materials is by a direct comparison with the other cast ferrous alloys. In this way, its advantages and disadvantages can be weighed against those of the other materials.

Fig. 1, from left to right, shows microstructures of graphite steels, malleable iron, grey iron, and nodular iron as well as representative physical properties. As has already been pointed out, the matrix in these materials is for all practical purposes the same as in steel of similar composition and treatment, and any change in their over-all properties or characteristics as represented by the matrix is, therefore, the result of the shape, size, and distribution of the graphite particles. It is readily seen that small, rounded, well-dispersed particles free from any sharp protrusions, will have a less detrimental effect on strength and ductility than large flakes perfectly shaped to produce high localised stresses and discontinuity of structure. On the other hand, it is also evident that the high damping qualities, as well as high resistance to heat-checking, typical of cast irons containing large flake graphite, will be adversely affected by a smooth, rounded, spherulitic graphite particle. Fig. 1 also shows the effect of the shape, size, and distribution of the graphite particles on the modulus of elasticity of these cast alloys. It will be noted that whereas cast iron has a modulus less than 20×10^6 lb. per sq. in., nodular irons, malleable irons, and graphitic steels range from 23×10^6, to 29×16^6.

* Paper presented at a meeting of the [American] Society of Automobile Engineers.



1 2 3 4 5 6

Sample No.	Type of metal.	B.H.N.	Yield point, tons per sq. in.	Tensile strength, tons per sq. in.	Elongation, per cent. on 2 in.	Reduction in area, per cent.	Modulus of elasticity, lb. per sq. in. × 10⁶.
1	1 per cent. C graphitic steel	183	24.5	40.1	16	20	29.3
2	1.5 per cent. C graphitic steel ..	255	42.4	58.6	6	8	28.0
3	Malleable iron	125	15.6	23.7	18	—	25.0
4	Grey iron	196	—	13.4	—	—	19.0
5	Pig iron..	139	—	10.7	—	—	8.6
6	Pig iron plus Mg	277	31.2	40.1	1.5	1.0	22.0

FIG. 1.—FERROUS CASTING MATERIALS: INFLUENCE OF GRAPHITE FORM ON PHYSICAL PROPERTIES.

Nodular Iron

The production of nodular iron, as is now well known, is generally accomplished by a two-stage operation. The first stage is that of the addition of cerium, magnesium, lithium, or similar carbide formers which promote the formation of white iron in an iron normally solidifying grey. The second stage is an opposing stage in which a ferro-silicon-type of inoculant addition overcomes the tendency toward white iron causing the graphite to precipitate in the form of small spherulites (Fig. 2).

Several theories have been advanced as to the exact mechanism underlying the formation of nodular graphite. It has been suggested that the presence of small amounts of magnesium, cerium, etc.. promotes under-cooling and stabilisation of the carbides forming on solidification so that they decompose at a lower temperature than that required to give under-cooled graphite.

Professor De Sy, of the University of Ghent, Belgium, has further proposed the theory that the nucleating particle governs the type of graphite formed. This opinion is based on the knowledge that the ideal centre of crystallisation is represented by a solid particle belonging to the same crystalline system as the material which is to crystallise. In conventional cast iron, therefore, according to De Sy, silicon particles having a hexagonal crystal-lattice promote the formation of hexagonal or flaky graphite. In nodular irons the presence of magnesium or cerium carbides or sulphides having a cubic crystal-lattice cause the carbon atoms to orient themselves according to the cubic system resulting in spherulitic graphite.

It is of interest to note that in many cases the centre of the spherulite is composed of a core or nucleus of a different substance from the rest. This is clearly shown in Figs. 3 and 4. So far as is known none of the proposed theories has, as yet. been proved, so for the present metallurgists must confess that the true mechanism is not fully understood.

Addition Agents

The choice of the carbide stabilising agent is governed largely by economic considerations which, at the present, favour the use of magnesium. In addition, limitations surrounding cerium and some of the other metals, such as the requirement that the iron in question be hypereutectic, do not apply to magnesium. In general, it can be stated that any iron which, including its ferro-silicon type of inoculant, solidifies grey can be made nodular by effective treatment with magnesium. The treatment itself. as stated above, is essentially the introduction of a small but effective amount of magnesium followed by a ferro-silicon inoculation. This magnesium may be introduced as a relatively pure

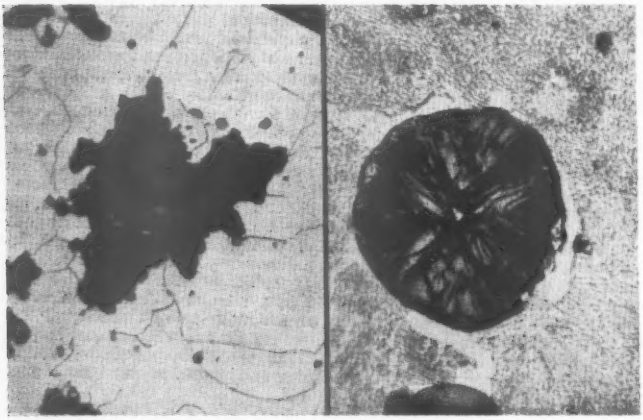


FIG. 2. — GRAPHITE OCCURRING AS SMALL SPHERULITES IN NODULAR IRON.

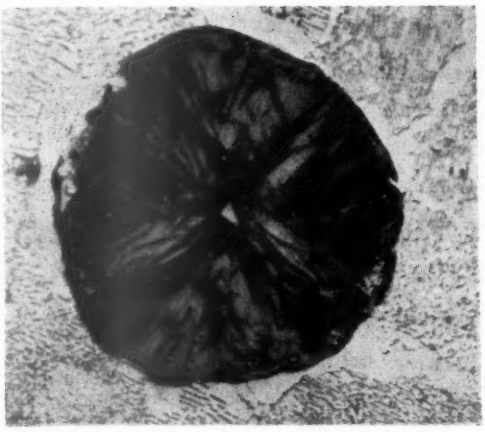


FIG. 3.—GRAPHITE SPHERULITE AT MEDIUM MAGNIFICATION SHOWING THE CENTRE NUCLEUS.

magnesium, as a non-ferrous alloy including magnesium, or as a ferro-silicon modified with magnesium.

It is obvious that with a boiling point of around 1,110 deg. C., magnesium becomes gaseous at molten-iron temperatures and reacts with explosive force in the presence of air. The magnesium-rich alloys are consequently more violent than those containing smaller amounts of magnesium. Likewise, it has been found that the recovery of magnesium in the iron is inversely proportional to the concentration of the alloy.

Numerous alloys have been investigated but most of these have been discarded in favour of magnesium/nickel, magnesium/copper, and (of late) magnesium/copper/ferro-silicon. In particular, the last is of interest in that this alloy eliminates the objections frequently raised to the addition of large amounts of nickel or copper which automatically follows when these elements are used as carriers. The relative amount of magnesium required to produce nodular iron depends upon the amount of sulphur present in that the first reaction following the addition appears to be the formation of magnesium sulphide, thereby removing the sulphur from the field of action. This reaction proceeds until the sulphur content approximates 0.02 per cent., at which point the magnesium becomes effective in changing the form of the graphite. At first, a gradual refinement and shortening of the graphite flakes takes place, but as increasing amounts of magnesium are added, it will be found that spherulites begin to form until a point is reached where the graphite has changed over to a completely nodular structure. Experience has shown that a minimum of 0.035 per cent. magnesium must be present in order to produce effectively completely nodular iron. If the recovery exceeds 0.1 per cent. magnesium, however, excessive carbide stabilisation occurs, ultimately resulting in a stable white iron.

Table I is presented in an attempt to show the approximate recovery in per cent. that can be expected for various magnesium alloys when added to an iron containing 0.03 per cent. sulphur in amounts sufficient to produce nodular iron. It must be understood that these figures are representative only of the particular practice peculiar to this experimental work and should not be treated as a yardstick. As will be shown later, the efficiency of magnesium recovery is influenced

TABLE I.—*Relative Efficiency of Magnesium Addition Agents in 0.03 per cent. Iron.*

$$\text{Per cent. mg recovery} = \left(\frac{(\text{Residual} + \tfrac{1}{3}\ \text{S drop})}{\text{Mg added}}\right) \times 100.$$

Alloy.	Mg recovery.
6 per cent. Mg/10 per cent. CuFeSi1	32
13 per cent. Mg/10 per cent. CuFeSi1	24
20 per cent. Mg/80 per cent. Cu1	19
50 per cent. Mg/50 per cent. Cu2	14

NOTES:
1 Added to stream at 1,480 deg. C.
2 Added to covered ladle at 1,480 deg. C.
Residual Mg, 0.08 per cent.

by several factors which must be carefully controlled, if consistent results are to be expected. The actual amounts of the various alloys shown in Table I required to treat a 0.03 per cent. sulphur iron at 1,480 deg. C. so as to recover 0.08 per cent. magnesium and the anticipated cost of treatment are shown in Table II.

TABLE II.—*Cost of Treatment.*

	Mg addition.[1]	Alloy weight per ton.	Alloy cost per ton melt.[2]
	Per cent.	Lb.	
6 per cent. Mg/10 per cent. Cu/FeSi	0.3	100	$15.00
13 per cent. Mg/10 per cent. Cu/FeSi	0.4	61	$10.40
20 per cent. Mg/80 per cent. Cu	0.53	53	$21.20
50 per cent. Mg/50 per cent. Cu	0.7	28	$11.20

NOTES:
1 Computations based on treatment of 0.03 per cent. S iron at 480 deg. C. to give 0.08 per cent. residual magnesium.
2 Assuming cost of 6 per cent. alloy $0.15 per lb.; 13 per cent. alloy, $0.17 per lb.; 20 per cent. and 50 per cent. alloys, $0.40 per lb.

The 0.08 per cent. magnesium residual referred to above is necessary in order to insure against losses of magnesium due to oxidation while holding in the molten state during pouring; it has been found that the magnesium residual decays at the rate of 0.001 per min. in the range of 0.08 to 0.04 per cent. residual magnesium. This means that under normal conditions the metal can be held about 30 to 40 min. provided, however, that the temperature is continuously decreas-

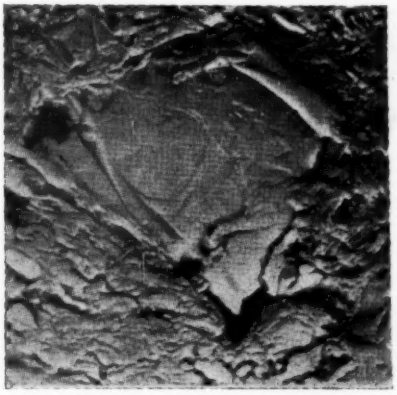


FIG. 4.—PHOTOGRAPH AT HIGH MAGNIFICATION OF THE CORE OR NUCLEUS INSIDE A GRAPHITE SPHERULITE.

Nodular Cast Iron

ing as in normal pouring practice. If heat is added, the rate of decay is accelerated. The selection of the most practical magnesium addition agent must be predicated on a proper balance between reproducibility in results, efficiency of magnesium recovery, influence of carrier metal on base analysis, amount of pyrotechnics consistent with safe practice, slag-forming tendency and chilling effect.

At the present time, personal experience indicates that the magnesium/copper/ferro-silicon alloys give very good results and meet most of the requirements mentioned. It is of interest to note that in the initial experiments with magnesium/ferro-silicon alloys, the reaction proceeded spasmodically with an appreciable amount of spatter and attendant crusty slag. With the addition of copper to these alloys, the spatter is eliminated and the slag is much more workable. The rapid progress being made in alloy development makes it, however, very possible that new alloys and new techniques of addition will soon appear which may render obsolete present notions.

Method of Alloy Addition

The addition of magnesium is customarily made in the metal stream or in the ladle at the time of tapping. The alloy may be introduced in a number of ways, either gradually or *en masse*, in either a finely divided state or in lumps as best suits the conditions imposed by metal temperature and the nature of the alloy. Using magnesium/copper/ferro-silicon alloys, it has been personal experience that by adding properly-sized alloy gradually to the stream as the furnace is tapped, uniform and reproducible results have been obtained. The size of the alloy will vary with the amount of metal treated from $\frac{1}{4}$ in. and down for 20- to 50-lb. ladles to 1 by $\frac{1}{2}$ in. for 10- to 15-ton ladles.

Effect of Metal Temperatures on Treatment

The metal temperature, *i.e.*, the temperature at which the magnesium alloy addition is made, has a considerable bearing on the relative magnesium recovery and consequently on the economy of the operation. The lower the temperature consistent with safe operation, the greater is the recovery. Whereas in Table I the recovery on a 6 per cent. magnesium/copper/ferro-silicon alloy is about 32 per cent. at 1,480 deg. C., the expected recovery at 1,370 deg. C., could such a temperature be used safely, is approximately 45 per cent. The chilling effect of the magnesium alloy and the inoculant makes it, however, necessary to treat the base metal at a considerably higher temperature than required for the satisfactory pouring of the casting; approximately 80 deg. C. in the case of the 6 per cent. magnesium alloy. This factor would seem to favour the magnesium-rich alloys such as 50 per cent. magnesium/50 per cent. copper, where smaller quantities of the carrier element are required. The increased volatility of these alloys, however, with the resultant reduced safety hazard, more than offsets this advantage; nor does it appear to be justified on a basis of cost.

Castability

The castability of the nodular irons after the treatment compares very well with the base iron in that the fluidity is as good or possibly slightly better. The gating and risering technique, because of the high liquid shrinkage, becomes a compromise between cast iron and steel. Pattern shrinkage depends somewhat upon the base iron, whether high or low carbon, but in general may be stated to be $\frac{1}{8}$ in. per ft.

Effect of Section Size

Nodular cast irons of normal grey-iron compositions are more susceptible to chill in light sections than is the base metal. It has been personal experience that it is difficult to avoid chilling in sections less than $\frac{3}{16}$ in. unless a high-silicon iron is used, with the resultant detrimental effect on physical and other properties. The effect of section size on the uniformity of physical properties is not noticeable in cross-sections up to about 4 in. Above this thickness, however, the ductility falls off rapidly and continues to do so, but at a decreasing rate as the section size is further increased. This is true not only in the as-cast, but also in the heat-treated condition, as will be demonstrated later (see Table VI).

Methods of Manufacture and Effect of Chemistry on Mechanical Properties

The source of the molten metal, be it blast-furnace, cupola, or electric-furnace, does not seem to have any appreciable influence on the casting or engineering properties of the nodular-iron family. This is not to say that the properties are independent of the chemistry, for it must be emphasised that definite chemical limitations exist, especially in the manufacture of the more ductile forms of iron.

Relatively few foundries have any choice in the matter of melting equipment, as the large majority especially in the grey-iron industry are equipped only with cupolas. The appreciable sulphur pick-up associated with cupola operations is, however, a distinct disadvantage in that most of this sulphur must be eliminated before the magnesium treatment becomes effective in re-shaping the graphite. This can be done by several means, such as conventional de-sulphurising methods and the use of additional amounts of magnesium alloy over and above that required for carbide stabilisation. The cost of such treatments is, however, an appreciable factor which cannot be overlooked. Those foundries which are equipped with electric furnaces may find it advantageous to use these units instead, as then a base iron of initially low sulphur, at controlled temperatures, can be produced, thereby reducing the required amount of magnesium alloy to a minimum.

Regardless of which unit is selected for the manufacture of nodular iron, a thorough understanding of the effect of the various elements on resultant properties is necessary in order to determine the proper chemistry to meet physical requirements. If the emphasis is on high strength with ductility as a secondary factor, a conventional cupola iron may be treated to produce an iron as shown on the left in Table III.

TABLE III.—*Properties of As-cast Nodular Iron.*

High strength.			High ductility.		
	Per cent.			Per cent.	
C	3.40	Yield point, 35.7 tons per sq. in.	C	3.50	Yield point, 24.5 tons per sq. in.
Si	2.50	Tensile, 44.6 tons per sq. in.	Si	2.60	Tensile, 35.7 tons per sq. in.
Mn	0.70	Elongation, 1.5	Mn	0.15	Elongation, 10.0
P	0.14	R. in area, 1.0	P	0.025	R. in area, 8.0
S	0.015	B.H.N., 255	S	0.015	B.H.N., 190
Mg	0.06	Elasticity, 24 × 10⁶ lb. per sq. in.	Mg	0.06	Elasticity, 24 × 10⁶ lb. per sq. in.

The microstructure of such an iron, as indicated in Fig. 5, is composed of a lamellar pearlitic matrix with spherulites interspersed. Should the emphasis, however, be on high ductility and resistance to impact (reference, for the moment, is made to the as-cast properties) the effect of manganese and phosphorus and, to a lesser extent, silicon and carbon must be carefully considered. Manganese adversely affects the

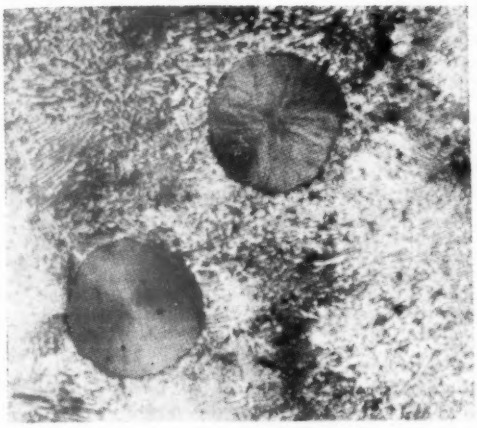


FIG. 5.—MICROSTRUCTURE OF TREATED CUPOLA IRON, COMPOSED OF A LAMELLAR PEARLITIC MATRIX WITH SPHERULITES INTERSPERSED.

ductility and should, therefore, be kept as low as economic considerations permit, preferably around 0.15 per cent. and not over 0.30 per cent. Phosphorus, as is well known, has a pronounced embrittling effect and must not exceed 0.04 per cent. for maximum ductility and impact.

Although high silicon and high carbon are desirable in that they promote ferrite precipitation and consequently produce irons of maximum ductility, it must be borne in mind that amounts of silicon in excess of 3 per cent. begin to harden the ferrite with resultant decrease in ductility. Similarly, high-carbon contents tend to produce more and usually larger nodules and as a result decrease strength, ductility and modulus of elasticity. Maximum ductility is, therefore, effected through a proper balance of these various elements, as shown on the right in Table III. The microstructure of such an iron, as shown in Fig. 6, is composed of a lamellar pearlitic matrix, with large bull's-eye ferrite surrounding each spherulite.

Melting Practice

Although most of the work described has been in connection with the electric furnace, numerous cupola heats have been made. In order clearly to indicate the technique used in producing nodular iron on production melting equipment, some typical heats made both in the cupola and the electric furnace will be discussed.

Cupola.—The cupola, of course, will be charged in the conventional manner. Closer control of manganese and phosphorus in the charge will, however, be necessary if an iron of good ductility is to be made. In addition, it is necessary to melt down with a lower silicon than normal because of the appreciable amounts introduced during the treatment, especially when magnesium ferro-silicon alloys are used. This, however, is advantageous in that it promotes higher carbon pick-up which improves castability without seriously reducing the physical properties.

In view of this, a typical spout analysis would be as shown in Table IV, predicated on using an addition of 0.50 per cent. magnesium in the form of a 13 per cent. magnesium-10 per cent. copper ferro-silicon alloy. This alloy is added slowly to the stream during pouring at a temperature of about 1,480 deg. C.

TABLE IV.—*Typical Analysis of Magnesium-treated Cupola Iron* (per cent.).

	Spout analysis.	Magnesium alloy addition.	Inoculant.	Final analysis.
C ..	3.50	—	—	3.50
Si ..	1.10	+1.2	+0.3	2.60
Mn ..	0.15	—	—	0.15
P ..	0.025	—	—	0.025
S ..	0.10	—	—	0.015
Mg ..	—	+0.5 (13	per cent. Mg/ Fe/Si	0.05

After the magnesium treatment, the metal is re-ladled into a pouring ladle, and a 0.30 per cent. silicon as a 75 per cent. ferro-silicon is added. It is important that a thorough mixing of the molten iron and the magnesium alloy as well as the inoculant is effected. The particle size of the inoculant must be controlled so as to produce maximum rate of solution and recovery. If the conditions described are carried out with reasonable care, a final analysis as indicated in Table IV will result.

It is essential that the cupola slagging operation prior to the magnesium treatment be effective, since the presence of any slag on the surface of the molten iron will result in a much lower yield and the hazard of the reaction proceeding with explosive force will be enhanced. As a result of the two treatments, a heavy, rather dry and powdery slag is formed which must be skimmed off before pouring, unless special precautions are taken such as the use of tea-pot or bottom-poured ladles. A definite evidence of oxide film on the surface of the molten metal is present, a factor which, although it does not seem to influence the castability of the iron, decreases the reliablity of optical means of temperature measurements.

Electric Furnace.—Numerous heats have been made in electric furnaces ranging in size from 500 lb. to 15 tons. A typical example of this type of manufacture is a high-strength, nodular-iron heat which was made in a 15-ton electric furnace. The charge here consisted of pig-iron of an analysis as shown in Table V. After melt down, the metal was heated to 1,480 deg. C. and tapped into two 8-ton treating ladles (necessitated by limited facilities for handling larger ladles). During tapping 0.4 per cent. magnesium again in the form

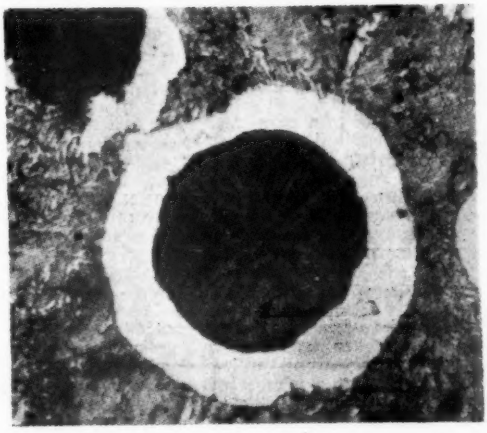


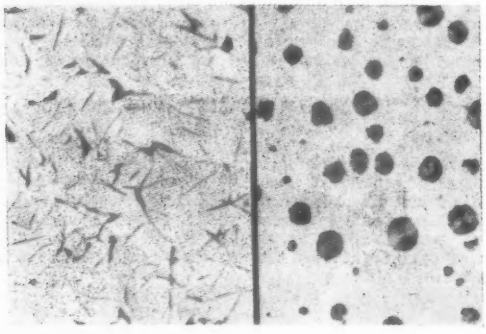
FIG. 6.—MICROSTRUCTURE OF HIGH-DUCTILITY IRON SHOWING LAMELLAR PEARLITIC MATRIX WITH LARGE BULL'S-EYE FERRITE SURROUNDING EACH SPHERULITE.

Nodular Cast Iron

TABLE V.—*Typical Analysis of Magnesium-treated Electric-furnace Iron* (per cent.).

	Analysis.		Magnesium alloy addition.	Inoc.	Final analysis.
	Charge.	Spout.			
C ..	4.00	3.80	—	—	3.80
Si ..	1.40	1.25	1.00	+0.30	2.55
Mn ..	1.15	1.00	—	—	1.00
P ..	0.15	0.15	—	—	0.15
S ..	0.04	0.04	—	—	0.018
Mg ..	—	—	0.40	(13 Mg/Fe/Si)	0.06

of 13 per cent. magnesium/10 per cent. copper/ferro-silicon alloy was added to the stream. The reaction was accompanied by the characteristic white flame of oxidising magnesium but with no tendency to spatter. Following the magnesium treatment, the metal was re-ladled into 1,500 lb. pouring ladles at which point 0.30 per cent. silicon was added as 75 per cent. ferro-silicon. After careful slagging, the metal was poured into conventional moulds, the temperature ranging from 1,355 deg. C. down to 1,315 deg. C. for the last ladle. The final analysis of this heat shown in Table V and the resultant physical properties are difficult to reconcile, but nevertheless are typical of this new material. Figs. 7 (*a*) and (*b*) show the change in the graphite formation as a result of the magnesium treatment.



(*a*) (*b*)

	(*a*)	(*b*)
Tensile strength (tons per sq. in.) ...	10.7	40.1
Elasticity (lb. per sq. in. x 10^6) ...	9.0	23.0
Impact (ft. lb. for 0.798 diam. bar) ...	13	40

FIG. 7.—CHANGE IN GRAPHITE FORMATION AS A RESULT OF MAGNESIUM TREATMENT CARRIED OUT ON ELECTRIC-FURNACE-MELTED IRON. (*a*) UNTREATED, AND (*b*) TREATED.

Direct Treatment of Blast-furnace Iron

It may be of interest here to note that the availability of molten blast-furnace iron in the Authors' works makes possible further simplification of the method and that a number of such heats have been made where the metal was transferred directly from the blast furnace to 15-ton electric furnaces, treated as above, and poured into castings. The objectionable features of double ladling is a handicap, particularly on a production set-up. It is, however, hoped that the extensive research under way on alloys will soon enable the process to be performed with a single treatment. Some investigators have reported that they are successfully producing nodular iron by means of magnesium/ferro-silicon alloy without having to resort to the inoculation treatment. It has been personal experience, however, that although nodular iron can be produced by magnesium/ferro-silicon alloys alone, or by simultaneous additions of magnesium alloys and ferro-silicon, this method lacks consistency in reproducing results from heat to heat, and appears to promote the presence of massive carbides.

Control

Regardless of whether cupola or electric furnaces be used, the method of control is of significant importance. Whereas conventional iron requires good control of the carbon, manganese, silicon, as well as phosphorus, sulphur and residual elements, nodular iron is much less sensitive to carbon and silicon, but much more so to phosphorus, sulphur, and in addition, residual magnesium. Although the correct amount of phosphorus and sulphur can be fairly well assured if care in the selection of the charge and operation is exercised, some uncertainty still exists as to the effectiveness of the magnesium reaction, *i.e*, whether the correct amount of active magnesium is present to assure a proper nodular structure. As the metal is ready to pour immediately after the treatment, no time is available to determine this by analytical means. Instead, faster, although perhaps less certain methods, must be resorted to. It has been personal experience that a chill wedge cast in a sand mould and fractured longitudinally after proper cooling offers a satisfactory substitute. Not only does the relative depth of chill indicate the degree of carbide stabilisation, but, furthermore, the fracture in the unchilled portion of a properly-treated iron has a light grey crystalline appearance. In addition, it has been found that the fracture of an under-treated iron gives off a strong odour of hydrogen sulphide when exposed to moist air whereas a truly nodular iron has an odour commonly associated with acetylene.

Effect of Heat-treatment on Physical Properties

Nothing has been said up to now about the response of these irons to heat-treatment. The very nature of the as-cast structures, however, suggests that they will respond in a manner similar to cast iron and malleable iron. Numerous tests have shown this to be the case, thereby further broadening the potential field of applications.

It must, however, be remembered that foundrymen are dealing with two distinct materials which, as a result of relatively small differences in chemistry, exhibit decidedly different degrees of ductility in the as-cast condition. This is clearly demonstrated in Table VI which also shows the effect of section size on physical properties in the as-cast, annealed, and quenched and tempered condition. It must be pointed out that the magnesium addition selected for this test was based on 2-in. cross-section in order to demonstrate the relationship between section size and the amount of magnesium required. An examination of the microstructures shows that the loss in properties in the heavier sections is, to a large extent, a result of insufficient amounts of magnesium. It is of interest to note that the presence of the higher manganese content in the high-strength iron appears to augment the magnesium. The selection of the proper amount of magnesium for a given size casting, therefore, must be based on the average casting size in order to obtain maximum nodular graphite in the heavy section without inducing excessive chill in the lightest section.

TABLE VI.—*Influence of Section Size and Thermal Treatment on Nodular Irons.*

Thermal treatment.			High-strength iron.						High-ductility iron.						
			Yield point, tons per sq. in.	Tensile strength, tons per sq. in.	Elongation, per cent. on 2 in.	Reduction in area, per cent.	B.H.N.	Elasticity, × 10⁶ lb. per sq. in.	Impact, ft.-lb.	Yield point, tons per sq. in.	Tensile strength, tons per sq. in.	Elongation, per cent. on 2 in.	Reduction in area, per cent.	B.H.N.	Elasticity, × 10⁶ lb. per sq. in.	Impact, ft.-lb.
As cast	.. ..	1	30.1	38.9	1.5	nil	269	23.0	39	23.6	33.3	11.0	8.8	187	22.1	50
		2	29.9	36.1	1.2	0.5	262	23.0		23.3	32.1	7.5	7.5	187	22.3	
		4	28.1	31.6	1.2	1.0	241	23.6		17.8	22.7	2.0	1.8	175	19.7	
		6	26.7	29.1	1.2	nil	229	22.7		16.9	20.1	3.0	1.2	148	15.6	
		8	26.3	27.4	1.2	0.5	229	23.5		14.0	18.3	2.5	1.0	141	17.4	
Anneal 615 deg. C.		1	27.4	37.1	3.0	2.5	229	22.8	183	21.8	29.5	17.2	15.0	163	22.2	> 260
2 hr. air cool		2	25.3	33.4	3.2	2.2	197	21.5		21.2	28.3	12.5	11.0	163	21.9	
		4	24.6	30.9	2.0	1.5	197	23.6		16.4	21.5	4.5	3.0	148	20.1	
		6	25.7	29.4	2.0	1.0	217	22.2		16.6	19.1	3.0	1.3	144	18.8	
		8	24.3	27.9	1.5	1.0	212	22.8		14.8	17.8	2.0	1.2	138	18.3	
Anneal 955 deg. C.,		1	22.9	35.1	7.0	4.5	187	22.4		20.3	28.3	19.0	16.0	148	21.1	
2 hr. slow cool		2	22.7	32.0	6.0	5.5	179	21.7		19.1	26.9	14.5	13.8	143	20.7	
		4	22.4	31.1	3.5	2.5	183	23.1		15.2	19.7	4.0	3.0	134	17.8	
		6	22.6	29.6	3.0	2.0	183	22.4		15.4	19.4	3.0	1.8	131	17.0	
		8	22.9	29.9	4.0	2.8	183	22.3		15.2	16.3	2.0	1.0	125	17.0	
835 deg. C. 1 hr., oil		0	42.5	46.5	3.0	3.0	269	21.9		41.0	47.0	3.5	3.2	269	21.4	
quench, draw 2 hr.		2	42.1	44.6	3.2	2.5	269	22.5		39.8	45.5	3.0	3.0	269	21.4	
to Brinell as shown		4	39.8	40.0	1.8	1.5	262	21.9		36.6	37.2	0.5	0.5	262	19.0	
		6	39.4	40.0	1.5	1.2	255	23.1		28.1	29.8	1.0	—	214	17.3	
		8	38.2	39.5	1.8	1.0	255	22.8		27.7	28.1	0.5	—	229	16.7	

In the interest of practical heat-treatment applications, it is desirable to compare the two-hour treatment at 615 deg. C. in Table VI producing an iron with an elongation of about 17 per cent. and a Brinell hardness of 163 and the longer treatment of 955 deg. C for two hours, furnace cooling at a controlled rate to 150 deg. C. resulting in an elongation of 19 per cent. and a Brinell hardness of 148. Much higher ductilities such as 25 to 28 per cent. have been reported by some investigators, but these can only be achieved by long heat-treatment cycles, which seem somewhat impractical except in specific cases where the properties developed can be fully utilised. The response of nodular irons to hardening treatments, either local or full, is very good. By oil quenching from 835 deg. C. and tempering, properties as indicated in Table VI can be readily attained. Typical microstructures resulting from these various treatments are shown in Figs. 8 to 15.

Machinability

The statement has frequently been made that the machinability of nodular iron is much better than that of conventional cast iron. Such a statement is apt to be misleading unless it is explained that the comparison is related to materials of similar physical properties. When such is the case, it is true that nodular irons machine better than flake-graphite irons. As the latter, however, are generally used in a hardness range of from about 167 to 248 Brinell as against 228 to 300 Brinell for nodular irons in the as-cast condition, any statement not clarified may be readily misunderstood. The Authors are, at the present, in the process of establishing the true machinability relationship between nodular iron and other graphitic materials.

Wear Resistance

The resistance of nodular irons when lubricated to wear is excellent in particular in the absence of any free ferrite, and compares very well with grey cast iron. Although the Authors have had no experience with its behaviour in conjunction with dry wear, the very nature of the graphite formation leads one to assume that the resistance to heat checking is lower in nodular iron than in cast iron, and consequently that the resistance to dry-wear will be lower. Some data have appeared in the literature which tend to substantiate this assumption.

Potential Applications

It is only natural that personal analysis of the uses to which this material may be put is influenced by the extensive application and outstanding success that non-flake graphitic materials have had in their own manufacture. This has been especially so in the case of their 1.0 and 1.50 per cent. carbon cast graphitic steel, the latter composition being that which is used in current crankshaft production. Some 20 million of these crankshafts have given excellent performance in service.

In an attempt, however, to approach the subject on a broader plane, the Authors would like to break down the potential uses to which nodular iron may be applicable into four groups on the basis of engineering properties.

The first of these is that entire field where a non-flake graphite in a selected matrix has proved so successful. From an engineering standpoint this would place nodular iron in direct competition with the various types of malleable irons as well as with the graphitic steels used by the Authors. An extensive testing programme to evaluate the suitability of nodular

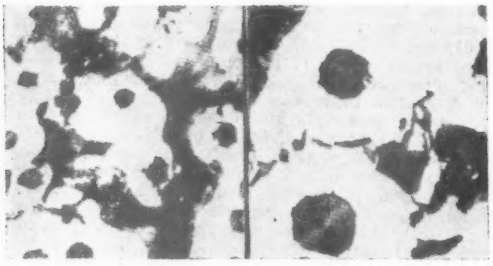


Fig. 8.—As Cast.

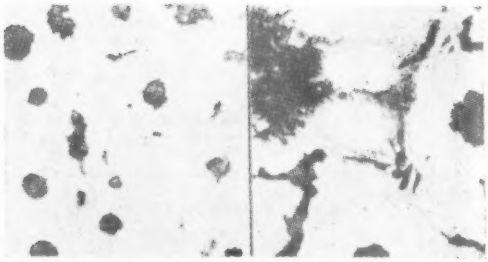


Fig. 9.—Held at 615 deg. C. for 2 hrs. and air cooled.

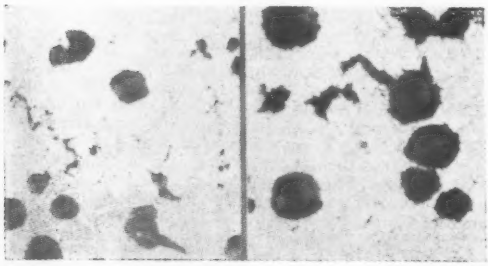


Fig. 10.—Held at 955 deg. C. for 2 hrs. and furnace cooled.

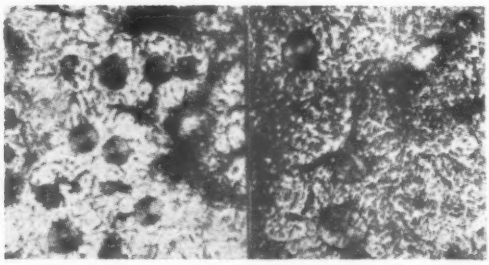


Fig. 11.—Quenched and tempered.

FIGS. 8-11.—HIGH-DUCTILITY IRON (LEFT, 2-IN. SECTION, RIGHT, 8-IN. SECTION) AS CAST AND AFTER VARIOUS TREATMENTS.

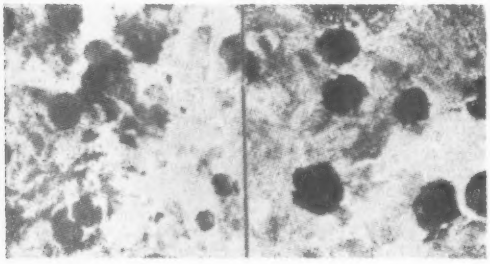


Fig. 12.—As cast.

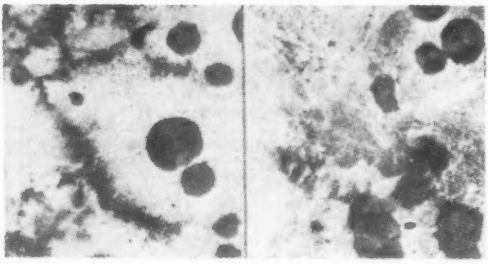


Fig. 13.—Held at 615 deg. C. for 2 hrs. and air cooled.

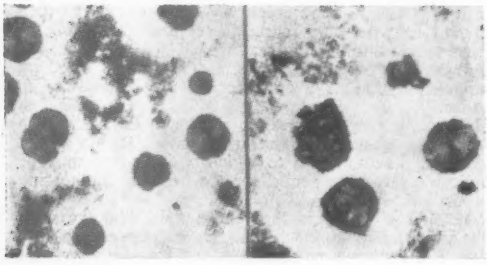


Fig. 14.—Held at 955 deg. C. for 2 hrs. and furnace cooled.

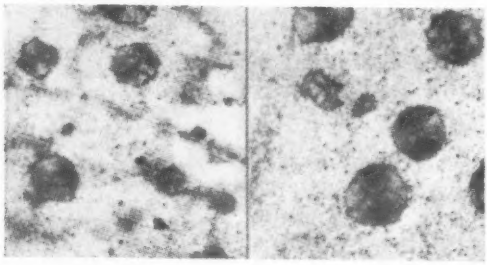


Fig. 15.—Quenched and tempered.

FIGS. 12-15.—HIGH-STRENGTH IRON (LEFT, 2-IN. SECTION, RIGHT, 8-IN. SECTION) AS CAST AND AFTER VARIOUS TREATMENTS.

TABLE VII.—*Physical Properties and Manufacturing Costs (Dollars) of Ferrous Casting Alloys.*

Specification.	Grey iron (S.A.E. 111).	Alloy iron per cent. Ni 0.80 Cr 0.20 Mo 1.00	Malleable (S.A.E. 35018).	Pearlitic malleable (S.A.E. 43010).	Steel (S.A.E. 0030).	Steel (S.A.E. 0105).	Nodular iron.		
							High-tensile.	High-ductility (as cast).	High-ductility (annealed).
Yield point, tons per sq. in.	—	—	15.6	19.2	15.6	37.9	35.7	24.5	20.1
Tensile strength, tons per sq. in.	13.4	31.2	23.6	26.8	29.0	46.9	44.6	35.7	29.0
Elongation, per cent. on 2 in.	—	—	18	10	24	17	1.5	10	16
Reduction in area, per cent.	—	—	—	—	35	35	1·0	8	20
B.H.N.	190	286	130	170	130	217	255	190	160
Elasticity (× 10⁶ lb. per sq. in.)	19	21	25	25	30	30	24	24	24
Impact ft.-lb. on 0.798 dia. bar	10	20	—	—	—	—	40	180	260
Type of melting unit	Cupola	Cupola	Cup./Elect.	Cup./Elect.	Elect. Fce.	Elect. Fce.	Cupola	Cupola	Cupola
Heat treatment	None	None	Anneal	Anneal	Anneal	Quench & temper	None	None	Anneal
Casting yield, per cent.	80	75	52	50	50	50	70	70	70
Relative Metal Cost :—									
Castings	40.81	70.73	40.40	40.95	31.85	46.84	59.64	63.86	63.86
Raw material	6.75	7.20	14.60	15.18	31.83	31.83	7.71	8.65	8.65
Conversion	—	—	9.00	9.00	9.00	18.00	—	—	6.00
Heat treatment	47.56	77.93	64.00	65.13	72.68	96.67	67.35	72.51	78.51

iron as a replacement for these graphitic steels in the manufacture of crankshafts has been under way for about two years in the Ford Motor Company. The results to date are very promising.

The second field where this material may find application is as a replacement for conventional cast iron where the strength, modulus of elasticity, resistance to impact, etc., has proved inadequate, or for the high-strength and acicular irons.

Thirdly, nodular iron may find application as a replacement for steel castings where the castability or machinability of the part in question may dictate its consideration. A noteworthy example of this is the work at Cooper-Bessemer cited by Eagan and James in the December 8 and 15, 1949, issues of *Iron Age*, where nodular-iron castings are indicated as comparing quite favourably with steel castings for component parts of engines and compressors.

Finally, there is some evidence to indicate that nodular iron may be hot worked in the neighbourhood of 955 deg. C. with good results. As personal experience in this field has been rather limited, the Authors would like to cite some of the very interesting work that Mr. J. E. Rehder is carrying out in the Laboratory of the Department of Mines and Resources in Ottawa, Canada. Mr. Rehder has been successful in hot rolling 3-in. cast slabs in two heatings to $\frac{7}{16}$-in. plate with a resultant tensile strength as rolled in the order of 62 tons per sq. in. with 4 per cent. elongation. The structure of hot-worked material, as shown in Fig. 16, is very similar to that of wrought iron, except that there is practically no pearlite in wrought iron, whereas the matrix in as-rolled nodular iron is completely pearlitic. From these findings Mr. Rehder concludes that since for the production of such material blast-furnace iron could be treated at the furnace and the ingots rolled directly into plates or bars the cost should be lower than for steel, suggesting immediately its use for concrete reinforcing bars, etc.

Critical Evaluation

In order to evaluate critically the importance of this material it may be helpful to study Table VII which shows the physical properties representative of various cast ferrous alloys and some figures pertaining to their relative cost of manufacture. Since it has not been possible, in personal work, to develop any exact data on cost, these figures as shown in Table VIII have been arrived at by using basic costs of raw materials (*Iron Age*, November 24, 1949), cost of magnesium alloys and treatments as indicated by the Authors' experimental work, conversion costs for various types of

TABLE VIII.—*Tabulation of Cost Summary of Ferrous Casting Alloys (Dollars).*

BASIS : Cost of Metal and Heat Treatment per ton of Castings.

Raw material.	Grey iron (S.A.E. 111).	Alloy iron 0.80 Ni 0.20 Cr 1.0 Mo	Malleable iron (35018).	Pearlitic malleable iron (43010).	Steel (S.A.E. 0030).	Steel (S.A.E. 0105).	Nodular iron.		
							High-tensile.	High-Ductility (as cast).	High-ductility (annealed)
Foundry pig iron	20.34	21.85					29.80		
Malleable pig iron			31.15	32.55					
Char. pig iron								30.00	30.00
Basic pig iron									
Steel scrap	5.25	5.60	9.25	8.40	28.00	28.00	9.98	14.00	14.00
Auto. cast iron	15.00	13.20							
Ferro manganese	0.22	0.44			1.73	3.02			
Ferro silicon					2.12	2.12	1.16	1.16	1.16
Ferro chrome		1.23				8.20			
Molybdenum		22.00				5.50			
Nickel		6.40							
Copper		3.50		7.00					
Magnesium alloy							18.70	18.70	18.70
	40.81	70.73	40.40	40.95	31.85	46.84	59.64	63.86	63.86
Conversion.									
Cupola	6.75	7.20					7.71	8.65	8.65
Cupola/elect. and air fce.			14.60	15.18					
Electric (based on steel)					31.83	31.83			
Heat treatment			9.00	9.00	9.00	18.00			6.00
Total	47.56	77.93	64.00	65.13	72.68	96.67	67.35	72.51	78.51

melting units as listed by A. W. Gregg (*Foundry*, February, 1949), and standard assumption as to melting and heat-treatment practice. From this it is evident that they can only serve as a guide in comparing the materials and conditions listed in Tables VII and VIII, and must be modified according to the practice peculiar to each particular foundry.

Assuming that the Authors' approach is valid and that their material, conversion, and heat-treatment costs are representative, the following conclusions seem justified:—

(1) That there is no immediate economic advantage in replacing present malleable-iron castings with

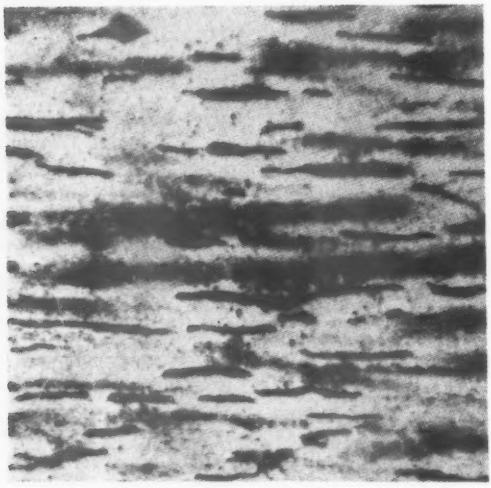


FIG. 16.—STRUCTURE OF HOT-WORKED NODULAR IRON.

nodular iron, but that its early application in the malleable field may be limited to section sizes larger than those possible at present.

(2) That the competition with grey irons will be solely on the basis of improved engineering properties except in the case of alloy irons where an economic advantage is indicated.

(3) That the use in the steel-foundry industry will probably be limited to cases where improved castability and machinability will offset an increased cost of manufacture.

In summarising the foregoing discussion, it may be said that nodular iron offers an engineering material which possesses properties never attained in flake-graphite cast iron. The potential applications for this material seem to be many and varied, but it is entirely too early to predict all of its eventual uses. Currently, certain economic barriers exist, such as cost of treatment and the need for high-priced raw materials. Indications are, however, that research in the U.S.A. and other countries will soon lead to developments which will permit nodular irons to assume a much more competitive rôle and thereby come into full use.

Acknowledgment

The Authors express their appreciation to the Ford Motor Company for permission to publish the data contained in this Paper, and to the Vanadium Corporation of America for their excellent co-operation in the development of various alloys; in particular, the magnesium/copper/ferro-silicon alloys.

Adding Pattern Details on Drawings

By "Checker"

In the normal course of working, the patternmaker is requested to produce patterns and coreboxes by working to a drawing, from which he can usually obtain information regarding the many items that are necessary in relation to the desired castings. There is not, however, anything on these drawings which can give him assistance in the actual construction of his pattern equipment. With the easier and simpler work, of course, none is necessary, but with more complicated jobs (and, generally speaking, pattern and foundry work is more complicated now than 20 yrs. ago) it would simplify the patternmaker's work if drawings were marked up with such necessary data as lengths of core-prints, the amount of machining to be allowed, if not specified on the actual drawing, the position of the moulding joint, whether hardwood or softwood equipment is required, the position and size of any core-prints for external cores, or loose pieces if required, whether full, half, or segmental core-boxes are to be made, etc. In fact all details should be added that will be of assistance, and should be plainly marked in ink or red pencil. When drawings have previously been marked up in this way, the patternmaker's time is saved, as he will not have to give consideration to these details which have been added on the drawing for his benefit. The preparation of drawings in this manner must, of course, be assigned to the foreman, or some other responsible person.

Drawings giving these pattern details may often save altering patterns. Sometimes patterns may be nearly completed, before information is received regarding the sizes of moulding boxes that are to be used, often with the resultant necessity for shortening of core-prints and coreboxes to the specified limits. It sometimes happens that details of moulding boxes or other equipment are available to the foreman, but not to the patternmaker, who is often left in ignorance as to plant and works to his own ideas at the beginning.

The arrangement of marking pattern details does seem to be gradually extending, as the advantages of such a method are being realised, and have in fact been in operation for some time, at a number of large progressive firms. Some may prefer drawings to be marked up by a patternmaker and foundryman working in consultation together, and this in some instances has much to recommend it. In any case, the person or persons responsible for adding pattern details will naturally have available all information regarding a particular job, including the production that will be required. Thus all details of the work are subjected to inquiry and investigation, decisions are made and agreed upon before the patternmakers are presented with drawings to commence making the equipment. Under the old system, far too often decisions are not made until patterns and coreboxes have progressed to an advanced stage.

Where patterns are fixed on plates or boards for machine moulding it is an advantage to also have such details worked out in advance, as the number of patterns to be fixed on each plate, the board or plate dimensions, the exact positioning of patterns and the positioning and dimensions of running arrangements. All these should be decided upon before the wooden patterns, or master patterns, if metal equipment is required), have been commenced.

MR. PETER KIEK, who was for several years manager of R. A. Lister & Cia., Ltda., Argentine, has been appointed technical sales engineer to R. A. Lister and Broom & Wade, Limited, for the whole of South America.

Leaders of the Industry

T. Makemson, M.B.E.

Mr. Tom Makemson, M.B.E., who has now been general secretary of the Institute of British Foundrymen for more than half the time that the Institute has been in existence, joined the Institute in 1917. In January, 1948, the Institute marked his 21-years' service by a special general meeting at the Waldorf Hotel, London, at which a lecture was given by Sir Arthur P. M. Fleming. That occasion was also celebrated by a luncheon held in his honour at which he received a presentation from the Institute. Some particulars of Mr. Makemson's career were published at that time,* but it is now possible to add further details.

Mr. Makemson was born at Workington, Cumberland, and served his apprenticeship as a patternmaker in that town. His early technical training was received at engineering classes in Workington and Manchester. He then took a five-year part-time course in metallurgy at the Manchester College of Technology, at the conclusion of which he was awarded the Associateship of the College. In 1911 he entered the employment of the British Westinghouse Electric & Manufacturing Company, Limited, of Manchester (now the Metropolitan Vickers Electric Company, Limited). For some years he combined his work as a patternmaker with that of a teacher of patternmaking and subsequently of foundry practice in the company's trade school. Later, he was promoted to a full-time post on educational and training work, and subsequently held a position in the research department.

MR. T. MAKEMSON, M.B.E.

His interest in technical-institution work started when he became an associate member of the Institute of British Foundrymen in 1917. In 1922 he was elected honorary secretary of the Lancashire branch and at the end of 1926 was appointed secretary of the Institute, relinquishing his position with Metropolitan Vickers. Six months later, he became secretary of the Manchester Association of Engineers, the fourth oldest engineering institution in Great Britain, and carried out simultaneously the secretarial work of that association and of the Institute of British Foundrymen for a period of 21 years, the combined duties leaving him little time for outside interests. From May, 1940, to July, 1946, he was seconded to the Iron and Steel Control, being successively deputy director, joint director, and then director for iron castings. This work brought him into contact with most iron foundries in the country, some hundreds of which he visited personally, and in the 1946 New Year Honours his services were recognised when he was created a Member of the Order of the British Empire. In the same year he was awarded the E. J. Fox Medal of the Institute of British Foundrymen for services to the industry and to the Institute. In this year, also, he was loaned by the Iron and Steel Control to the Control Commission for Germany and spent some weeks in that country.

Soon after his appointment as secretary of the Institute of British Foundrymen he became honorary secretary of the International Committee of Foundry Technical Associations, and has held that position ever since. In this capacity he has visited foundry conferences in many European countries. He has twice visited the United States, and on the second occasion, in April, 1946, led a party of foundrymen which was one of the first groups of British industrialists to visit the United States since the war.

In June, 1948, Mr. Makemson resigned his post with the Manchester Association of Engineers and was elected an honorary life member. Since then he has devoted himself entirely to the Institute of British Foundrymen and other work arising out of this secretaryship. He has been hon. secretary of the City and Guilds Advisory Committee on Patternmaking and Foundry Practice for 20 years and for some years he was joint examiner with Dr. Pearce. He is a member of the council of the British Cast Iron Research Association, and an honorary member of the *Association Technique de Fonderie*.

* FOUNDRY TRADE JOURNAL, January 22, 1948.

EX-PROVOST J. K. SHANKS, M.B.E., D.L., J.P., the former head of Cruikshank & Company, Limited, celebrated his 80th birthday on February 19, and from his many friends received congratulatory messages. Ex-Provost Shanks is a well-known figure in the Scottish ironfounding industry and, despite his weight of years, still enjoys a day out with his fishing rod or gun. His residence is at Beechfield, Glasgow Road, Denny.

SIR HOLBERRY MENSFORTH, who, owing to advancing years, has decided to give up his business connections, received a presentation of a piece of old silverware at a special board meeting of John Brown & Company, Limited. The presentation was made by Lord Aberconway, the chairman, on behalf of himself and his colleagues. Lord Aberconway said that on the occasion of Sir Holberry's retirement from the board of Westland Aircraft, Limited, his colleagues desired to mark their appreciation of his services to John Brown & Company and their associated undertakings. Sir Holberry has been on the boards of many companies, including Dalton Main Collieries, Limited, Markham & Company, Limited, Markham Steam Coal Company, Limited, Thos. Firth & John Brown, Limited, and Tredegar Iron & Coal Company, Limited.

Book Reviews

"The Solidification of Castings." By R. W. Ruddle, M.A. Published by the Institute of Metals, 4, Grosvenor Gardens, London, S.W.1. Price 10s. 6d.

As stated on the dust cover, this book is primarily intended for the research worker, but its claim to be of interest to the practical foundryman is also justified. It is a review of the literature concerning rates of solidification and temperature gradients in castings, and the aspect of macrostructure is not considered in detail. This field of research is a comparatively new one, the greater part of the experimental work described having been published during the last twenty years. The review provides a clear picture of the present state of knowledge, and should stimulate interest in this important aspect of foundry research.

The investigations described in the first part of the book were made with the prime object of obtaining information of direct value to the foundryman concerned with the design and production of sound castings. "Directional solidification" and the means of attaining it are considered. Sections of particular interest are those on gating and feeding methods, the design of feeders, and the use of chills and moulding materials of different thermal properties.

In the second and major part of the review, investigations of the fundamental principles of solidification are described. There are four main experimental techniques, namely, mathematical analysis, "pour-out" methods, direct temperature measurement, and electrical analogue methods. Practical experimental details are not the prime concern of the review, but the main results of the various workers are described in a critical, comprehensive and comparative manner.

To the metallurgist, the mathematics of solidification may appear formidable, but the Author has presented the main outlines of the theory in a way which enable the salient features and conclusions to be appreciated without requiring an extensive knowledge of advanced mathematics. The theory of continuous casting is also briefly reviewed.

The direct experimental studies are described under the headings of sand and ingot castings, the greater part of the work being ferrous. There is a separate section on the use of electrical analogues. A few of the figure headings would have been improved by including a statement of the composition of the steel referred to in the figure. In Fig. 20, for example, the steel in question contained 0.24 per cent. C. The occurrence of the peritectic reaction in such a steel explains the discontinuity in two of the curves showing the per centage of solidified metal. Again, in Figs. 35-38, it would have been advantageous to give the composition (in this case 0.20 per cent. C) and freezing range of the steel. In Figs. 38 and 39 the temperature scale is given in error as deg. C. instead of deg. F.

The review is well indexed, and is liberally illustrated throughout with well-chosen graphs from the original Papers. The extensive list of references, 161 in number, will enable those interested in particular aspects to make a closer study. There is a valuable Appendix, in which the Author has tabulated the most reliable of the available data on the thermal properties of a wide range of mould materials, and of metals in the liquid and solid states. D. W.

Pattern Making. By J. G. Horner, A.M.I.M.E., revised by P. Gates. Published by the Technical Press, Limited, Gloucester Road, Kingston Hill, Surrey. Price 18s.

Fundamental and basic principles of a craft seldom change with the advent of modernisation, especially where applied to work such as patternmaking. For that reason the reading and digesting of the contents of this book must have an edifying effect on the average journeyman patternmaker, help the puzzled apprentice along his thorny path towards proficiency, and be a useful reference book to those not so intimately concerned with the art and mysteries of patternmaking.

Being an eighth edition, it will be obvious that the over-all merit of this book has been well accepted, and in regard to wood patternmaking of a general type, the text and illustrations cover a comprehensive range, with a leaning, somewhat naturally, to work of prominence at the time of origination. The sections on elementary moulding practice are particularly recommended to the student.

Whilst there is a glimpse of developments in metal patterns and plate-pattern work, as well as some illustrations of modern machinery for this purpose, little is written of the present-day application of these and other additions to the practice in to-day's first-class patternshop. None the less, the sound material embodied within 390 pages of practical technology makes this book well deserving of recommendation to all interested in patternmaking. B. L.

How to Appeal against Tax Assessments. By J. H. Burton. Published by Jordan & Sons, Limited, 116, Chancery Lane, London, W.C.2. Price 12s. 6d. net.

If anybody is a little nervous as to appealing against an income tax assessment, this book will go far towards removing this condition, as it clearly shows in twenty chapters what steps to take, the hearing, appeals, costs, and so forth. The reader is told just what *certiorari* and *mandamus* mean and, in general, the book defines legal expressions so that they are readily understood by the layman. The reviewer is no expert on this subject and wonders whether many of his readers know that many tax practitioners deem it wise "to lodge a formal notice of appeal against every notice of assessment received." Apparently, this is helpful in arriving at an agreed settlement (not easy), though, of course, it can be changed later. The book is well annotated by references to cases heard and established, and it should certainly be a useful addition to the collection of books accumulated by company secretaries. At the published price it appears to be good value. The publication date is March 24. V. C. F.

Oil Prices

The Minister of Food announces that during the four-week period ending April 1, 1950, the following alterations in the prices of unrefined oils will apply:—

Linseed oil	From £126	to £132	per ton	naked	ex works
Linseed oil (foots) ..	,, £76	,, £82	,,	,,	,,
Castor oil (firsts) ..	,, £98	,, £115	,,	,,	,,
Castor oil (seconds) ..	,, £91	,, £108	,,	,,	,,
Whale oil, No. 3 grade ..	,, £99	,, £85	,,	,,	,,
Whale oil, No 4 grade ..	,, £91	,, £75	,,	,,	,,
Whale oil/herring acid oil	,, £58	,, £70	,,	,,	,,
Whale oil, acid oil, hardened	,, £93	,, £90	,,	,,	,,
Mixed sunflower/whale acid oil	,, £58	,, £70	,,	,,	,,

The prices of all other unrefined oils and fats and technical animal fats allocated to primary wholesalers and large trade users will remain unchanged.

Institute of British Foundrymen — *East Midlands Branch*

Production of Metallurgical Coke

Discussion of Mr. M. D. Edington's Paper

After reading his Paper on the "Production of Metallurgical Coke"* to the East Midlands branch of the Institute of British Foundrymen (Mr. C. A. Payne presiding) at their December meeting, MR. EDINGTON said that, in order to place the discussion on a proper basis, he was satisfied that the three main plants in Durham, which were together responsible for over half the foundry coke made in this country, were now sending out coke of pre-war quality.

MR. BUTTERS felt that coke was not of such good quality as in pre-war days, possibly due to the deterioration in quality of the coal being mined at the present time. Since the mines were nationalised, it was well known they had made a loss, but they had striven to get output in terms of tonnage rather than quality. His foundry was sometimes having what was termed good-quality Durham coke, and during the last six months there had been some shocking consignments. A fortnight ago there was a load which more resembled ordinary gas-oven coke. What was the difference between South Wales coke, which was always termed the best, and Durham coke? Regarding coke being passed over a 4-in. mesh, the speaker referred to a new storage bunker, built two years ago, for South Wales coke which was invariably used for the bed. There was now more than 2 ft. of "fines" in the base of that bunker. As this was supposed to be a very hard coke passed over a 4-in. mesh screen, he would like an explanation as to why it was that there was so much of the "fines" in the bunker.

Welsh versus Durham Coke

MR. EDINGTON, speaking with reference to the question of South Wales *versus* Durham, said the South Wales producers had at their disposal an appreciable amount of coal with the volatile between 10 and 20 per cent. which could be blended with higher-volatile coal to give a mixture averaging 24 per cent., which was the peak figure for coke quality. In Durham, blending was not so necessary, as the coals available have a uniform volatile matter content of about 26 per cent. South Wales had therefore a slight advantage in the coking properties of the coal used. As to the "smalls," even though there was a boom loader, when the coke was dropped into wagons, there was bound to be some breakage, but he would like to ask the speaker how much the fines referred to represented as a percentage of the total consumption.

MR. BUTTERS said he was receiving something like 8 tons per week. The bunker, carrying about 25 tons, had been in use 18 months, and there was at least 2 ft. of very small coke, small enough to be riddled and sent to the blacksmith's.

MR. EDINGTON said that worked out at about 1 per cent., which did not seem excessive. There was bound to be some further breakage after the coke left the ovens, but if this was too high, then the customer had a right to complain.

MR. BUTTERS pointed out that, when it was put into the hoppers at the cupola the furnace was taking quite a percentage of small coke, although much was being left in the bunker.

*Originally presented to the 1949 Conference of the Institute of British Foundrymen, and printed in the JOURNAL, August 4, 1949.

MR. A. RUSSELL, referring to the question of whether or not coke was as good as it was, said that it might be agreed that it was so on analysis, but the change from the old-type to new-type ovens had produced a change in physical properties of coke. Whether foundrymen like it or not, they had got to get used to the new type of coke. What foundrymen desired more than anything was a regular quality of coke. When a "bad" truck was received, it caused real trouble, as it was not realised until the metal had "gone off" in the cupola and half a day's work was wasted in consequence.

As to whether the future ovens should be 21 in or 18 in. wide, some foundrymen insisted they must have coke in 10-in. pieces. He personally did not think it mattered whether it was 10 in. or 6 in. so long as one could be sure of getting a regular supply. He asked for an expression of the meeting on this point. As a representative of the Institute on a committee investigating this matter, the question has been posed, "Was it really necessary to have very big coke?" and no one knew the answer. He personally did not think it was, so long as it was reasonably large with a high shatter index, and was also uniform and strong. People working very large cupolas, as they did in the Nottingham district, might have different views. He had no experience of these large cupolas.

He was also rather worried about Durham coke in general, as Mr. Edington said 60 per cent. of the cupola coke came from Durham. He understood that the seams in Durham were working out fairly rapidly. This process had been going on for 100 years or more, the best coal being used up a long time ago, and the mines were now yielding poorer- and poorer-quality coal. To some extent, the trouble was being overcome by washing and cleaning, but the picture seemed rather gloomy, as it might be that in 50 years' time the foundry industry would not get any Durham coke.

He thought consideration should be given to the handling of the coke. According to Mr. Edington, the men threw it about until it was screened, but after screening it was handled with care. The foundrymen also threw it about, allowed rain and frost to reach it, then transhipped it and charged it into the cupola with a terrific crash. Coke of good shatter index was when it could be dropped from 6 ft. on to a solid slab and 95 per cent. would remain of the 2-in. size. How many times did foundrymen drop coke 6 ft.? Every time 5 per cent. was broken into smalls. He did not think coke was handled as carefully as it should be.

Coking-plant Reorganisation

MR. EDINGTON said all the main coking plants at which foundry coke would be made in the future were being re-built and modernised and, when this programme was completed in a year or two, users would be assured of constant and regular quality. At most foundry coke plants the washeries were under the control of the coke-oven manager and this ensured that the chemical properties of foundry coke would be maintained.

MR. LILYMAN asked what kind of technical controls were used for determining calorific values, etc. Was any attempt made to compare coke from the various batteries?

Discussion on Foundry Coke

MR. EDINGTON insisted that the properties of the West Durham coking coal were reasonably constant and regular routine tests were carried out on the coke for chemical properties, shatter, abrasion, hardness and ignitability. In practice it was being found that the coke produced in each battery did not vary unduly, although the sizes might be different when one plant was compared with another due to the width of the oven and carbonising temperature.

MR. DOCKSEY said that in the modern coke oven everything possible was done to make good coke. It would be interesting to learn what kind of coke would be given using a modern coke oven and the fuel used for coking 20 to 30 years ago, or, alternatively, what kind of coke would be produced with the present coal in the coke ovens of 20 years ago?

With regard to Mr. Russell's remarks as to the size of coke, a medium-size coke was the best in the average cupola. In big ones it might be necessary to have larger coke. The whole question seemed to hinge on the raw material for the coke ovens.

MR. EDINGTON said that, in former times, coal with less than 5 per cent. ash could be used straight from the pit without further treatment, but now all coal must be washed in order to get the same results; in other words, close control had to be exercised, whereas in earlier days it was unnecessary. The Coal Board had made further progress in regard to the installation of coal-cleaning plant during the past twelve months, and coke quality had improved compared with two or three years ago, and nowadays it did compare not unfavourably with that made 20 or 30 years ago.

MR. H. P. MILLER, supporting Mr. Russell's remarks as to the size of coke, said he had in mind particularly the large-diameter cupolas referred to. Medium-size coke about 7 to 8 in. was quite suitable in a 6-ft. to 7-ft. dia. cupolas. Regarding a certain type of coke, his experience had been that it would not withstand stocking and weathering, and it was very often necessary to pick up this brand of coke with a shovel instead of a fork. This was peculiar to this one brand, for other brands of coke behaved much better in the stockyard.

Handling and Storing of Coke

MR. C. A. PAYNE, who presided, first spoke in reference to the deterioration from weathering. When founders bought materials such as sand or ganister, they were careful not to let them get wet and then frozen. Coke was a porous material, but, unlike a sponge, it could not be wrung out. To get the pores filled with water and then the water converted to ice, the expansion must set up disruptive forces within the coke, irrespective of blend or grade. It was fairly general practice, but very wrong, to store coke in the open. He had very great difficulty in convincing himself as to how coke quality had changed. The only solid assessment to date of quality was in the actual melting process in the cupola. Members could give the lecturer a much more certain guide if they were in possession of information as to the precise differences in performance.

Were foundrymen using more coke to get identical results, or the same quantities, being content with lower temperatures? Were they trying to get more out of the coke, for example, melting higher steel-charge contents, driving the furnaces harder and for longer periods, and with more exacting demands as to analytical tolerances? Could they say that they were melting the same type and proportions of materials in the same furnace and at the same rate now as before the war, but the difference in coke required was represented by a definite measure?

Further, in the case of size and consistency, like Mr. Russell, he felt it was the continued variation which posed the major problems. If they could get a coke consistently bad, then they would know what to do, but when one consignment was of "pre-war vintage," and the next "the worst ever received," expediency often must displace control. A typical example was that of a particular source of Welsh coke. From one battery of ovens, the size is about 4 to 6 in. with the longest dimension about 7 to 8 in.; from another battery, the sizes may range from the 4 to 6 in. up to 12 in. or more, and the width from the "cauliflower end" to the "green fingers" (roughly half the over width) was about 11 in. With this larger coke, excessive ranges of volatile matter content from outside to inner surface had been proved. Surely that was something over which the coke-oven operators should have control.

With ovens operating at a higher temperature for a shorter period of time, was the effect of slight variation in the time temperature cycle going to be more pronounced than with slower and cooler working?

Beehive *v.* Modern Ovens

MR. L. HEARNSHAW, referring to a previous speaker's question regarding using present-day coal in old-fashioned beehive ovens, reminded Mr. Edington that he produced slides showing beehive ovens at present in operation, and the coke produced was of a particularly large size. Would Mr. Edington say if the physical properties of this coke were such as was required by foundrymen?

MR. EDINGTON said the difference between beehive and by-product coke was a matter of opinion; one might almost say prejudice. For instance, the remaining beehive battery in Durham had an order book extending into 1951; on the other hand, a colleague from South Wales, in answer to a similar question, had stated that he had now closed down all his beehive ovens. Beehive coke was loaded entirely by hand, but he could show other slides of beehive ovens in which the coke in the wagons was smaller and of not such an attractive appearance as that exhibited.

MR. R. C. SHEPHERD said Mr. Edington had not indicated what were the properties of the raw coal which controlled the final quality of the coke. He has said that certain ranges of volatile matter were necessary to produce satisfactory coking, but was there something else which decided the final quality of the coke? With the modern methods of raw material control, coke producers ought to be able to get more uniform results. Most members knew their complaints about inferior coke dated back to the time when coke ovens were modernised. Was there something now taken out in the by-products which adversely affected the coke quality.

Regarding the best size of coke, surely the size and weight of the cupola burden controlled this. Large coke sizes were found to give the best results when heavy-section metal pieces had to be melted. For normal-size metal pieces, 6-in. coke was usually satisfactory. He personally, however, still preferred to use beehive coke from which he obtained the best results.

MR. EDINGTON said that on his own plant, by-product and beehive ovens worked side by side for over 30 years and, judging from the number of complaints, both cokes gave equal satisfaction. In the beehive oven, the gases ascended the long way of the coke and, by depositing carbon, might add to the strength. Quenching inside the oven certainly improved the appearance. He could not see that the removal of by-products could make much difference; in the beehive oven, the gases and part of the coke were burnt away inside the oven to supply the necessary heat, but in the by-product oven the gases

are led away to flues alongside. There were at one time a number of beehive ovens working in which the gases were burnt in flues underneath the oven and the coke produced was no different from that obtained from the usual type.

MR. MARSHALL, speaking as a coke-oven manager, said one question he passed over rather lightly was how long Durham coking coals would last. A life of 50 years was given about 10 years ago, and it was still given as 50 years. How much was left and what was going to happen when it was finished? Would blending make it last longer? In the case of batteries of the beehive type and modern ovens using the same raw material, a better coke would be yielded by the former. Was it that the flue temperature was higher? No one knew what the temperature was in a beehive oven. Increases in temperature and coking rate, he thought, had a great effect on the quality of the coke. In 1938 he tested some Durham coal from Mr. Edington's plant and some from South Wales at various temperatures and in two different sizes of oven. Speaking from memory, the faster and higher temperature coke was distinctly poorer than the coke produced in 48 hours. There was no doubt temperature played a very big part in the physical character of the coke.

MR. EDINGTON said the coal reserves in Durham were approximately 250 million tons, equivalent to 50 years' life. The life of the coalfield was a question of economics. There was, for instance, a 14-in. seam of superb coking coal untouched in many areas, as it was difficult to mechanise production from such a seam and work it at a low enough cost to produce foundry coke at the price which the user was prepared to pay.

With reference to the cokes mentioned by Mr. Marshall produced from the same coal at different coking times, although these cokes were different in size, the foundries they were sent to for testing did not find much difference in performance between those made at 48, 36, and 28 hours' coking time, but although they were able to use that made at 18 hours, it was stated to be rather small for their requirements.

Individual Requirements of Foundrymen

MR. H. PINCHIN, referring to the point mentioned by Mr. Russell regarding size of coke for larger cupolas, thought the main point was the output required from the cupola. In cases where a high melting rate was required, it was important to have large-size coke. He remembered a particular instance when a battery of cupolas was working on a certain coke and it became necessary to use some old Welsh stock, which was larger than current supplies, and the melting rate increased by some 5 to 10 per cent. It was important that the coke was regular in size; otherwise it was bound to create more resistance to the passage of the blast through the cupola, with consequent uneven distribution.

Personally, he thought the most disturbing feature about present trends in coking practice was the tendency towards standardisation. If five different foundrymen gave their opinions on the deterioration in coke, there would probably be five different views, simply because there were different characteristics demanded by the conditions in individual foundries, and the foundryman had to find out the best coke suited to his particular conditions. To-day, the small ovens which produced coke with individual characteristics were giving way to larger batteries producing a more standard supply of coke, thus limiting the choice of the individual foundryman.

MR. R. C. SHEPHERD asked if the coal was washed before crushing to remove the dirt. Was there any assurance that there was no dirt left in the lumps which would not wash out.

MR. EDINGTON said all the coal going to the washery was crushed to about 2 in. before washing, which was sufficient to free any dirt bands. If crushed to a very fine size, the cost of washing would be increased from 1s. 6d. to 12s. 6d. per ton, as special plant would be necessary. Flotation plants were normally employed for treating slurry, but were not feasible from an economic point of view for the general run of coal.

MR. BUTTERS thought the whole question resolved itself into one of acceleration in production. Though there may be a strong complaint from a customer, the coke makers could not alter the modern methods. That plant would not give foundrymen a coke comparable in quality with coke made from a slower process.

Mr. Marshall had given, he thought, the soundest contribution to the discussion. He said that the slower-process coke was superior to that made on the accelerated modern method. With regard to the President's remarks as to looking after coke, members should bear in mind that the truck might have been subjected to rain or frost several times before delivery. Founders now stocked coke under cover, but this did not alter what happened *en route*. Mr. Marshall, also, had raised the question of size, and he confirmed that it was very important to maintain regularity of size. Uniformity spoke for itself. When a bed charge was being made up, the coke was dropped some 20 ft. and on top of that an average of ½ ton of metallic materials in, say, ¼-cwt. lumps. To compare that with the test method of a 6-ft. drop was puerile. He personally thought one of the worst features of the products from coke ovens was that the coke was definitely softer and the weight of the furnace burden crushed it.

MR. EDINGTON said he knew very little about marketing of coke, but he thought, if a foundryman found a particular size which suited him, he should make his wishes known to the Coal Board. He must not think, if he wrote to them and received a curt letter back, that they had taken no notice, as these things did get passed on to the people concerned. All complaints were looked into and users who had any suggestions to make should make them, as eventually they reached the coke-oven manager, who was most anxious to produce the coke required.

MR. MILES also believed that foundrymen were getting a poorer quality of coke. At the same time they heard about the increased output of the individual miner. Was there any check at the coke-oven plant on the quality of the coal passed on for production of coke?

MR. EDINGTON said that at the Durham foundry-coke plants both the washeries and ovens were under the control of the coke-oven manager, who now was given every opportunity by the authorities to choose the type of coal he required to produce the best-quality coke. It meant that the Coal Board did realise the importance of the foundry industry, and there was a large scientific staff who kept a close check on the incoming coal and there were samplers at work 24 hours a day. The coke-oven manager could not, of course, control the ash in the raw coal as it came from the pit, but the washeries removed the dirt before the coal came to the coke ovens.

MR. C. A. PAYNE, commenting on the risk of coke becoming frozen *en route* to the user, said the same risk applied to sand and ganister, which one endeavoured to minimise by insisting on sheeted wagons (if one could get the sheets). He was amazed at the restraint and mildness of the discussion this evening, when he thought of all those awful hours foundrymen have spent on and around the cupolas because of the uncertainty of the coke available. Members opened a wagon of fresh material, and immediately anticipated trouble. Because they " sat on the job " they

Discussion on Foundry Coke

managed to win through without too much upset. The next wagon was visually the same as the previous one, and there the similarity ended and the trouble recommenced.

Although there were many tests which could be, and were, applied to coke, there was no known test which would provide the main answer, "Would it melt iron satisfactorily?" Visual assessment, a matter of experience and empirical knowledge, which left much to be desired, was so often the most practical criterion, apart from the results of the melt, by which time, of course, anyone could say whether it was bad coke or not. It was true to say that there had been a tendency towards improvement and a slightly greater consistency over the past 12 months, but strength was still not what it should be. Why this was so, analyses certainly could not tell.

His last query was about sulphur in coke. This occurred either as a volatile constituent (the probable source of sulphur pick-up in melting) or as sulphur in the ash which was most probably absorbed and retained in the slag. Was the Coal Board sufficiently aware and interested to watch this point, and was it possible to get information on this matter from the coke ovens?

MR. EDINGTON said that most washeries attached to foundry-coke plants were dealing with nothing else but foundry-quality coal. At one particular washery which had a certain amount of spare capacity, high-sulphur coals were washed on a separate shift and sent out elsewhere for the production of blast-furnace coke. As previously mentioned, practically all the foundry-coke plants would have been overhauled more or less completely in the near future and approximately half of these would consist of 21-in. ovens operating at coking times of about 29 to 30 hours, so that there was going to be a wide range of foundry cokes available, down to 4-in. cubes from certain of the modern plants, and it was for the foundry people to say which kind they preferred for their own particular conditions. In Durham, three out of four plants would be operating wide ovens and slow coking rates, but it was understood that the new foundry-coke plant in South Wales would probably be 18 in. Good progress in regard to the reconstruction of foundry-coke plants had already been made, but it would be some little time before the full programme was completed. He sincerely hoped that the slight improvement in quality noticed by the chairman recently would be continued and that in the future foundry customers would have much less cause for complaint.

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and Davis; "The Hot-working of Tin-bronzes," by Showell; "The Hot-working of Lead and Lead-rich Alloys," by Back; and "The Rolling of Zinc and Zinc-rich Alloys," by Roberts and Walters.

5.00 p.m.—Meeting adjourned.

8.00 p.m.—Conversazione at 4, Grosvenor Gardens, London, S.W.1. (Tickets, price 7s. 6d. inclusive of buffet supper.)

Friday, March 31

10.00 a.m.—General meeting at 4, Grosvenor Gardens, London, S.W.1, with discussion of Papers:—"The Application of X-ray Methods to the Determination of Phase Boundaries in Metallurgical Equilibrium Diagrams," by Owen and Morris; "The Mechanism of Deformation in Metals, with Special Reference to Creep," by Wood and Rachinger; and "Recrystallisation of Single Crystals after Plastic Bending," by Cahn.

1.00 p.m.—The meeting will conclude.

Institute of Metals

Annual General Meeting

The Annual General Meeting of the Institute will be held in London from March 29 to 31. On the opening day, Wednesday, March 29, there is to be the induction of the new president, Mr. H. S. Tasker, followed by the presidential address. This function is to be held at the Café Royal. At the luncheon following, the Institute of Metals (Platinum) Medal for 1950 will be presented. An all-day symposium on "Metallurgical Aspects of the Hot-working of Non-ferrous Metals and Alloys" is to be held in the hall of the Institution of Mechanical Engineers on Thursday, March 30, and a conversazione will be held during that evening.

The Council has thus provided a suitable opportunity for members to meet each other, in appropriate circumstances, during this annual event. The luncheon is regarded as a domestic affair, and there will be no speeches except those associated with the presentation of the Platinum Medal to the distinguished French metallurgist, Prof. Albert Portevin. It is hoped that there will be a large attendance to do honour to Prof. Portevin, who was elected an Honorary Member in 1940. The following is the detailed programme:—

Wednesday, March 29

10.30 a.m.—General Meeting at the Café Royal, Regent Street, London, W.1. On the agenda are:—Institute business; report of Council; report of the honorary treasurer; election of officers for 1950-51; presentation of the first award of the W. H. A. Robertson Medal and premium; induction of the new president, Mr. H. S. Tasker, B.A. (chairman of Goodlass Wall & Lead Industries, Limited), and votes of thanks to the retiring president (Sir Arthur Smout, J.P.) and other officers; and presidential address by Mr. H. S. Tasker.

12.00 noon.—Adjournment. Cocktails will be served in the reception room reserved for the Institute on the fourth floor. 12.30 for 1.00 p.m.: Luncheon, for members and male guests only. (Tickets, price 18s., inclusive of coffee and gratuities.)

3.30 p.m.—General meeting at the Institution of Mechanical Engineers, Storey's Gate, Westminster, London, S.W.1. Discussion of Papers:—Scheuer, "Modern Billet Casting, with Special Reference to the Solidification Process." 4.30 p.m.: Tea interval. (Tickets, price 1s. 6d.) 5.00 p.m.: Joint discussion of three Papers: "Grain Refinement of Aluminium and its Alloys by Small Additions of Other Elements," by Eborall; "The Mechanism of Grain Refinement of Sand Castings in Aluminium Alloys," by Cibula; and "The Effect of Grain-size on the Tensile Properties of High-strength Cast Aluminium Alloys," by Cibula and Ruddle. 6.00 p.m.: Meeting to be adjourned.

Thursday, March 30

10.00 a.m.—General meeting at the Institution of Mechanical Engineers. Symposium on metallurgical aspects of the hot-working of non-ferrous metals and alloys, including "The Hot-rolling of Aluminium and its Alloys," by Kasz and Varley; "The Extrusion of Aluminium Alloys," by Smith; "The Hot-forging and Hot-stamping of Aluminium and its Alloys," by Stokeld; and "The Hot-working of Magnesium and its Alloys," by Wilkinson and Fox.

1.5 p.m.—Buffet luncheon, price 6s. (for ticket-holders only).

2.30 p.m.—Symposium to be resumed, with "The Hot-working of Copper and Copper Alloys," by Cook

(*Continued at foot of previous column.*)

Note on the Identification of Pattern Plates

By B. Levy

Some confusion in the application of the wrong title to a pattern plate having occurred, the following definitions are intended to help in the establishment of some standard terms for application to pattern plates of particular types.

Matchplates

Any pattern plate, irrespective of material, having part of the pattern on each side, *viz.*, both sides of its flat surfaces, could be termed a match plate. In other words, a match plate is for use on both sides, and is therefore a double-sided plate.

Cope and Drag Plates

Cope and drag plates are most frequently used on paired moulding machines. The plates in this instance are also in pairs, and have pattern sections on one side only of each cope plate and drag plate respectively. Although they are manufactured to mate with each other, they would not be used as a single plate. Cope and drag plates of this type are usually clearly marked with the name of their respective half-mould, and, of course, form the best equipment for high-speed mould production.

Single-sided Turn-over and Match Plates

The title single-sided turn-over and match plate may seem unduly lengthy, but, being completely descriptive of the purpose and type of plate to which it applies, is quite appropriate. These plates are mainly suited to medium and small classes of production castings where the cod is not too great to handle on the cope part mould. Patterns on this type of plate are so arranged that the drag half-mould and the cope half-mould are identical about the centre line, and will consequently match accurately together when two half moulds are rammed-off the one pattern plate and turned over on the appropriate centre line.

Whilst these notes are not intended to be an exhaustive treatise on pattern plates in general, the three main classes indicated and identified form the basis of most plate-moulding pattern equipment, irrespective of the material from which the plates and patterns are made.

House Organs

Craven Machine Tool Gazette. Vol. X, No. 3. Published by Craven Brothers (Manchester), Limited, Vauxhall Works, Reddish, Stockport.

This edition is, as usual, excellently illustrated by pictures of the firm's latest productions. Extensions, we are told, have recently been carried out and amongst these is a new fettling-shop building, internal and external views of which are illustrated. The front cover carries an impressive picture of a lathe installed in the works of the English Steel Corporation and capable of taking work up to 86 ft. long. It can be used as two lathes if desired.

S. & W. Magazine, March, 1950. Issued by Smith & Wellstood, Limited, Bonnybridge, Scotland.

Announced in this issue is the re-opening of the showrooms at Conduit Street in the West End of London, which took place on March 6.

Correspondence

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

CORE-OVEN FATALITY

To the Editor of the FOUNDRY TRADE JOURNAL

SIR,—With reference to the article, "A Core-oven Fatality," appearing in the March 2 issue, the following thoughts may interest your readers.

I feel the suggestions already made are inadequate because: (*a*) They may interfere with work by the action of heat, and (*b*) all assume that the trapped workman will be physically able to reach the escape device and operate it before being overcome.

In my experience of seeing how stoves are filled I think anyone trapped may have considerable difficulty unless the present capacity for moulds per unit stove volume is reduced. This must be considered as economically undesirable. Assuming that the man would either be trapped at the sides or back of the carriage, I would offer the following suggestions, to be used individually or collectively to solve the problem more surely and at reduced expense.

1. A strong wire around the sides and rear of the stove at carriage height passing out through a pipe of suitable size inserted in the wall at the door should be installed in every stove. The wire should pass immediately into an airtight box in which a switch working against a light spring could be so arranged that short sharp pulls on the wire at any point inside the stove would alternatively make and break an electric circuit connected to the foundry hooter. The signal should not be confused with any other, and on being heard should demand an immediate examination of all stoves in use.

2. Where more than one stove was in use at one time, the one circuit could be made to operate both hooter and a lamp placed on the switchbox. Thus only one stove need be opened.

3. The circuit might be further extended so that at any time desired the signal would operate in any other place chosen.

4. The circuit might yet again be extended to operate a motor to move a damper to shut off the heat from the stove.—Yours, etc.,

GORDON FOSTER.

Ovenden, Halifax.
March 5, 1950.

Mechanical Handling Exhibition and Convention

The full programme has now been announced for the convention which is to be held at Olympia, London, from June 6 to 17, concurrently with the second Mechanical Handling Exhibition, the world's largest display of labour-aiding equipment. The exhibition, with a floor area exceeding 200,000 sq. ft., will be more than twice as large as the first exhibition in London in 1948 and will include every type of equipment. Convention sessions will be at 11 a.m. and 3 p.m. daily, usually one Paper being discussed in the morning and one in the afternoon.

LEOPOLD LAZARUS, LIMITED, metal merchants, etc., announce their new board of directors as follows:—E. Wolff (chairman), E. Josephs, A. A. Lazarus, B. H. Wax, M. Wax and M. Zarnovecky.

Company News

The paragraphs below have been extracted from statements circulated to shareholders, speeches made at annual meetings, and other announcements.

R. A. Lister & Company, Limited, engineers and ironfounders, of Dursley (Glos):—In pursuance of the programme of replacement and expansion at the various factories at home and abroad, the company had spent, during the past year, on buildings, plant, and machinery the sum of £420,000, and outstanding commitments amounted to over £400,000 in respect of orders actually placed, said the chairman, SIR PERCY LISTER, at the recent annual meeting. Additional expenditure during the current year would accompany the installation of the machinery and plant comprised in the amount of £400,000, and they anticipated some outgoings on building extensions. The reorganisation programme was planned to be completed during the present year.

The sales figures for the year under review had established new records, and during the first quarter of the current year the ratio of increase had been fully maintained. "As the benefits of our extensive production reorganisation programme permit of a reduction in costs, it is our intention, compatible with the overall interests of the business, to pass such benefits on to the consumer," said Sir Percy.

International Combustion (Holdings), Limited (formerly International Combustion, Limited):—The chairman, MR. G. R. T. TAYLOR, says that during the year under review a steady flow of orders received has been maintained. The company's main products consist of equipment required for the raising of steam for the generation of electricity in the most efficient and economical manner and, in this connection, the company is keeping abreast of its programme so that it is in a position to take its fair share of this vital work. A considerable increase in production has kept pace with the amount of orders received and has been accelerated by the coming into operation of factories in Australia and South Africa.

In accordance with the reorganisation plans a valuation has been made of the fixed assets of the company as at October 1, 1949, so that these may appear at their present-day values in the accounts for the current financial year.

Le Grand, Sutcliff & Gell, Limited, Southall (Middx):—The company's export trade during the year ended September 30, 1949, was nearly doubled in value, oilfield equipment being mainly exported to South American countries and the Far East, says the chairman, MR. C. P. NEWMAN. He points out that the export of such equipment which was previously supplied by the U.S.A. "is a contribution towards the solving of the dollar problem."

Core Seating Bars

By "Tramp"

In certain classes of foundry work, where the jobs carry fairly heavy cores, the sand forming the core print or seat is insufficiently strong adequately to support the weight of the core placed upon it. Consequently, if no provision were made to guard against crushing of the print, the core would be too low in the mould, thus making the cored hole eccentric with the casting. To counteract this tendency, the moulder rams over the core seat an iron bar, which carries the weight of the core when the mould is assembled.

Fig. 1 shows a case where seating bars are necessary to carry a core which forms the exterior of a certain type of crankcase. In this instance, the amount of print available, compared with the depth of core in the

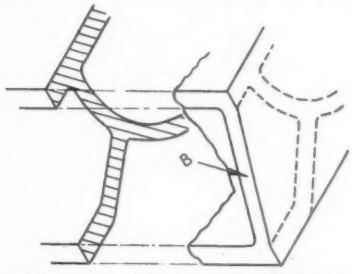

FIG. 1.—CRANKCASE CASTING, THE EXTERIOR SHAPE OF WHICH IS FORMED BY A CORE.

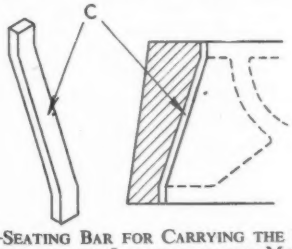

FIG. 2.—SEATING BAR FOR CARRYING THE CRANKCASE CORE AND ITS LOCATION IN THE MOULD.

mould, is small, due to the presence of the ribs or brackets, B, at each end of the casting. Consequently, a piece of iron, bent into the shape of the print as shown at C, is placed against the pattern and rammed in position (Fig. 2). Thus when the core is assembled, although the weight of the portion projecting into the mould tends to topple it forward, the resistance offered by the seating bar prevents it from moving.

New Catalogues

Shaker Hearth Conveyor Furnaces. A folder just issued by Birlec, Limited, Tyburn Road, Erdington, Birmingham, 24, describes and illustrates a new method of hardening small components. By means of a shaker mechanism the charge is sent forward at controlled intervals ranging between 3 secs. and 2½ min. through an electrically-heated furnace. After passage through the controlled-atmosphere furnace, the charge enters a water or oil bath or, in some cases, a salt bath. The tank is fitted with a removable tray, so the complete process is virtually automatic. There is a neatness about the whole set-up which is characteristic of the British electric-furnace designer. The layout of the leaflet is distinctly pleasing.

Core Binders. British Industrial Plastics, Limited, 245, Oxford Street, London, W.1, have recently issued a leaflet "Instructions for the Use of Beetle Resin W 20 for Bonding Foundry Sand Cores." Four mixtures are detailed together with an indication of uses and physical properties. This leaflet, which is available to our readers on application to the Oxford Street address, should find a place in the trade-literature file of all foundry establishments.

Alterations in Patent Law

By F. J. Tebbutt

A feature of the law of patents is that it is international, that is, between those countries which subscribe to the conventions of the International Union for the Protection of International Property, so that if protection is given to an invention in one country, similar protection can be obtained in any other such country. A new Act—the Patents Act, 1949 (which came into force January 1, 1950)—makes various alterations in the law arising from the recommendations of the Swan Committee and in some instances brings our law more into line with most of the countries of the Union. It might be of interest to mention in passing that the first known patent granted in this country was as long ago as 1449, so the Act under review—1949—is dated 500 years after.

Procedure for Application and Grants

An important alteration of the application procedure for a patent, relates to persons who acquire rights in an invention from the inventor, so that these (i.e., assignees) can now apply for a patent, either alone or jointly with any other person, but the true and first inventor must sign a declaration that he assents to the application being so made. Before this Act, the inventor was required to make the application, although he may have assigned his rights, but the assignee could join in the application if he chose. Moreover, at present, an application can be taken over by an assignee, if the assignment has been made after the inventor had applied for a patent. In some cases, a declaration as to the inventorship may be required to be supplied along with the *complete specification*.

A patent now dates from the date of the filing of the complete specification, and not from the date of application as previously. It should be noted that a complete specification need not be filed until 12 months (in some cases 15 months) after the application, although a provisional specification must accompany the application. This really means that, in practice, the life of a patent will be longer (ordinarily, the term is for sixteen years, although extensions can be obtained if proper action is taken) and also the increases in the fees which apply as time advances will not apply as early as previously. If there is a question of priority, the date of the provisional specification, however, will apply (for Convention patents, the date of application is used).

New grounds for objecting to the patent have been introduced, such as: that the invention was used before the priority date claimed in the complete specification; that the invention is obvious and does not involve any inventive step having regard to what was known or used before the priority date; and that the subject of any claim of the complete specification is not an invention within the meaning of the Acts. Incidentally the term "invention" has been altered so that it is now: " . . . any manner of new manufacture, and any new method or process of testing applicable to the improvement or control of manufacture and includes an alleged invention."

Ordinarily, a patent runs for sixteen years, but extension can be obtained if it is proved that the patentee has been inadequately rewarded by his patent, and there is also what is known as the "war losses" rule, where extensions are given if the war has prevented the patent being properly worked. The fact that extensions have been obtained through the last-named provision does not prevent the first-named ordinary rule applying; incidentally a sole licence holder can apply for extensions of a patent now under this "war losses" rule, the same as the patentee. When a patent is granted, for it to be effective in law, it must be what is termed "sealed," that is, sealed with the seal of the Patent Office, and if no application is made for such, within the time allowed (in the ordinary way, the time limit is 21 months from the date of application or longer in special cases) the patent lapses. Under the new Act, even though the time limits have passed, the Comptroller can order the patent to be sealed, if application is made within six months after the time allowed, and it is proved that failure to apply earlier was unintentional.

Licences of Right

A patentee can grant a licence to work a patent, to any person, but instead of doing this to particular persons, he can require the comptroller to endorse the patent "Licences of Right," which really invites anyone to take out a licence, and the terms can be agreed upon between the parties; if they cannot agree on these the comptroller can settle terms. Where this endorsement is made, the renewal fees for the patent are half the amounts otherwise payable. Formerly, the comptroller was required to advertise the request for an endorsement in the official Patents Journal, but this is not now required. However, he must notify any person shown in the Registrar as having an interest in the patent. Objections can be made to this general licence business, and if an objection is sustained and the endorsement consequently cancelled, the liabilities of the patentee revert to what they were before the endorsement, and the fees payable become the ordinary fees. If there have been licences granted before an endorsement is made, provision is made for adjustment of the terms between the patentee and such licence holders, if requested by either party.

Abuse of Patent Rights

The grant of a patent really gives monopoly rights, but there are provisions in the Act to prevent abuses of these. After a patent has run for three years, any person interested, and who may contend that there have been abuses of these rights, can apply to the comptroller for a licence, or for the patent to be endorsed "Licences of Right," and if the comptroller is satisfied that the grounds upon which complaint is made are established he can make an Order in accordance with the application, thus granting a compulsory licence. The Act lays down the grounds on which application under these provisions can be made (these have been increased by the 1949 Act), some of these being: that the patent is not being commercially worked in the United Kingdom or to the fullest extent; that the working of the invention is being hindered or prevented by the importation of the patented article; that the manufacture, use or sale of materials not under the patent is unfairly prejudiced by conditions, etc., imposed by the patentee upon grant of licences, that the demand for the patented article is not being met on reasonable terms, or is being met to a substantial extent by importation. Other grounds are that by reason of the refusal of the patentee to grant a licence an export market is neglected; the working of any other patent which may have an associated relationship to the master patent is hindered or prevented; or the establishment or development of commercial or industrial activities in the country is unfairly prejudiced. A new provision gives power to Government departments also to apply for the endorsement of a patent "Licences of Right," that is, if there exist any of the grounds upon which a compulsory licence may be granted as shown above, in the case of private applications.

Publication Received

Application of Aluminium and its Alloys to Passenger Road Service Vehicles. Issued by the Aluminium Development Association, 33, Grosvenor Street, London, W.1.

The notion of addressing sales activities to one section of industry is not new, but it has much to commend it. For one thing, the appeal seems to be more personal than when one finds—as so often is the case—just a casual reference that the selling firm or group has some sort of interest in your needs. The reviewer is no expert in road transport, and is perhaps unable properly to appreciate the technical aspects, but he is enthusiastic as to the layout and illustration. He would suggest, however, for pages 18 and 19, that by carrying over one line a better balance would have been achieved. The brochure covers three types of vehicles—tramcars and double- and single-deck omnibuses.

Home and Overseas Steel Prices Compared

British Levels well below American

Home-trade prices of the principal steel products in the United Kingdom are now very substantially below those of the United States of America. This is made clear in a table published by the British Iron and Steel Federation in its latest statistical bulletin, from which it will be seen that the advantage is commonly of the order of 25 to 30 per cent. British prices also are generally below the levels of other European prices.

The prices in the accompanying table are per ton of 2,240 lb., and are at January 15, 1950, according to the latest information. The general basis of comparison is tested steel in 20-ton lots, 5 tons of a size, delivered to consumer's station. Exceptions are re-rolled bars and hot-rolled strip (2 tons of a size, 20-ton lots), rails (500 tons of a size, fot makers' works), sheets (25 tons of a size), and tinplates (50 tons of a size). The prices are for the steel commonly used in each country, which is Siemens-Martin, except in France, Germany, Belgium, Luxemburg, Netherlands, and Spain, where it is basic-Bessemer. In these countries a substantial extra is charged for open-hearth quality. In some cases where the sizes, etc., shown are not standard in the country concerned the prices are for the nearest standard sizes, etc.

Electricity Undertakings' Expenditure

Total expenditure by authorised electricity undertakings in this country, including the Central Electricity Board, during 1947-48, the last financial year completed, or almost completed, prior to nationalisation, amounted to £900,420,000, compared with £838,115,000 in 1946-47. According to details published by the Ministry of Fuel and Power, net capital expenditure during the year amounted to £62,305,000 in 1947-48, compared with £43,516,000 in 1946-47.

Net total revenue from working (exclusive of all sales of electricity in bulk) was £183,313,000. Together with revenue from other sources, and after deducting working expenses, this provided a gross surplus for the year of £53,527,000.

The British Electricity Authority is understood to have placed contracts in Italy for the supply of nearly 4,000 low-pressure water valves required for British power stations. There is at present considerable congestion of orders on hand by British manufacturers, and since this congestion will be intensified by the increased demands for valves for water services by the Ministry of Health, the B.E.A. decided it was necessary to seek alternative sources of supply abroad to avoid delay in the commissioning of the new generating plant.

Design in Business Printing

An exhibition, "Design in Business Printing," presented by the Council of Industrial Design and the British Federation of Master Printers, at Murray House, London, S.W.1, opened on March 3 and closes on April 6, after which it is hoped to show the exhibition in Scotland and the provinces, and it may also be circulated in Commonwealth countries. The exhibition demonstrates that the communication of information and ideas effectively and pleasantly by means of print is the concern of every business house in the country. The prospective client or customer often forms his first impression of a firm from its printed matter, whether it be a visiting card, a letter head, a prospectus, or a poster.

It is hoped that this exhibition will:—(i) Show business men the value of a high standard of design in their commercial printing; (ii) show that high standards are widely maintained throughout Britain's printing industry; (iii) provide printers' apprentices and students of typography with a comprehensive display of good business printing, and (iv) illustrate a standard of design in printing that will be worthy of the industry in the 1951 Festival of Britain.

Product.	UK.	USA.	France.	Germany.	Belgium.	Luxemburg.	Canada.	India.	Sweden.	Australia.*	South Africa.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£A s. d.	£ s. d.
Angles, 5 in. × 5 in. × ½ in.	19 13 6	33 4 0	24 18 11	21 11 1	23 16 1	25 8 1	30 18 2	24 7 6	26 9 3	18 5 0	22 8 0
Joists, 12 in. × 6 in. × 54 lb.	20 3 6	33 4 0	21 13 7	20 4 4	—	24 15 8	30 18 2	24 7 6	23 0 7	18 5 0	22 19 3
Plates, 20 ft. × 5 ft. × ¼ in.	21 14 6	34 0 0	29 1 2	22 10 6	25 18 11	27 5 2	30 18 2	27 6 9	—	19 5 0	26 6 5
Heavy bars, 4-in. dia.	21 13 6	36 0 0	24 18 11	21 0 9	23 17 6	25 9 7	32 0 0	24 14 8	28 0 3	18 15 0	24 12 10
Re-rolled bars, 1-in. dia.	22 9 0	35 12 0	24 19 10	20 10 4	22 15 9	24 7 5	30 10 11	24 19 6	28 0 3	18 5 0	23 4 10
Hot-rolled strip, 3 in. × 10 swg	23 4 0	37 12 0	25 19 7	23 17 9	—	27 2 6	—	—	26 19 6	21 0 0	—
Alloy steel bars (3½ per cent. Ni), 2-in. dia.	48 18 0	62 0 0	—	—	—	—	—	—	—	68 14 9	—
Rails, 90 lb. per yd., 60 ft.	19 2 6	29 0 0	24 2 9	21 8 6	25 8 0	26 13 5	—	21 16 6	—	17 12 6	21 16 10
Sheets, 6 ft. × 3 ft. × 20 swg	28 6 0	39 12 0	35 1 1	32 10 7	—	—	38 3 8	30 10 6	33 13 8	37 0 0	27 10 0
Tinplate (per basis box)	2 0 6†	2 12 10†	3 10 7	3 6 8	—	—	—	—	—	—	—

* Prices in £ sterling are 20 per cent. lower. Prices are subject to 10 per cent. sales tax. † F.o.t. makers' works.

Obituary

PROF. GEORGE WILLIAM TODD, Professor of Experimental Physics, King's College, Newcastle-upon-Tyne, died recently.

MR. SAMUEL HILL, who died on February 14, was a director of Hill, Pritchard & Hill, Limited, galvanisers and hollow-ware manufacturers, of Lye, Stourbridge (Worcs).

MR. PETER MACDOUGALL PULLAR, who was with James Anderson & Company, Limited, manufacturers of firebricks, ganister bricks, etc., of Bonnybridge (Stirlingshire), for over 50 years, died on February 21. He was in his 88th year.

MR. GEORGE EDWARD WINDELER, of the firm of Rhodes & Windeler, consulting engineers, of Manchester, who recently died at the age of 75, served an apprenticeship with the firm of Walker Bros. (Wigan), Limited, and a term as draughtsman with Ferranti, Limited, Hollinwood (Lancs). He then joined the staff of Mirrlees Watson & Company, Limited, engineers and foundrymen, of Glasgow, later becoming chief engineer with Mirrlees, Bickerton & Day, Limited, Diesel engine manufacturers, of Stockport. After 25 years with that firm he began practice with Rhodes & Windeler, which he controlled until his death. Mr. Windeler served terms as vice-chairman and chairman of the Manchester branch of the Institution of Mechanical Engineers.

Wills

COLTART, C. B., formerly for many years managing director of Henry Wood & Company, Limited, chain, cable, and anchor manufacturers, of Saltney, near Chester, and also a director of Lloyds British Testing Company, Limited ... £112,690

BOOCOCK, HERBERT, late secretary of Denham's Engineering Company, Limited, Halifax £74,213

MARSDEN, FRANK, chairman and managing director of Joseph Stubbs, Limited, textile engineers and ironfounders, of Manchester £48,179

DOVE, G. F., a director of Cowans, Sheldon & Company, Limited, crane manufacturers, of Carlisle £22,092

BRATT, L. G., founder of Bratt Colbran, Limited, fireplace, electric and gas fire manufacturers, of Wembley (Middx) £18,722

ASPELL, S. F., formerly a director of the Wycliffe Foundry & Engineering Company, Limited, Lutterworth £17,710

MCKECHNIE, JOHN, secretary of the Mirrlees Watson Company, Limited, engineers and ironfounders, of Glasgow £2,443

HENNESSEY, JOSEPH for over 50 years with Kitson & Company, Limited, engineers and ironfounders, of Leeds £2,081

Chrome-ore Prices Reduced

The Ministry of Supply announces that, as a result of a reduction in ocean freight rate on chrome from Beira and Lourenço Marques, the selling prices for ore from these ports has been reduced by 7s. 6d. a ton for despatches from March 1. The new prices, per ton, ex ship, which include carriage charges to nearest rail point, consumers' works, are as follow, the prices ex store being given in parentheses:—

REFRACTORY—Rhodesian Imperial grade, £10 16s. (£11 13s.).

METALLURGICAL—Rhodesian lumpy, £11 2s. (£11 19s. 3d.); Rhodesian washed concentrates, £10 11s. (£12 11s. 3d.).

CHEMICAL—Transvaal XL, basis 50 per cent; scale 2s. 6d. above 50 per cent., £10 12s. 3d. (£11 11s. 6d.); Transvaal "A," basis 48 per cent.; scale 2s. 6d. above 48 per cent., £9 3s. 6d. (£10 2s. 6d.); Transvaal concentrates, basis 48 per cent.; scale 2s. 6d., £9 1s. 3d. (£10); Rhodesian Dyke chemical, £11 3s. 6d. (£11 18s. 9d.).

News in Brief

MASSEY-HARRIS, LIMITED, Sale (Ches), have received an order from Argentina for more than £750,000 worth of agricultural machinery.

THE REGISTERED OFFICE of Associated Portland Cement Manufacturers, Limited, is now at Portland House, Tothill Street, London, S.W.1 (telephone: Abbey 3456).

WILLIAM NEWMAN & SONS, LIMITED, brassfounders and hinge manufacturers, of Birmingham, celebrated their bicentenary this week. The company began operations at Wolverhampton, but transferred to Birmingham in 1881.

THE OFFICIAL INDEX of industrial production (1946 = 100) is estimated provisionally at 131 for December, 1949, compared with 139 for November. Figures for the same months of 1948 were 123 for December and 129 for November.

PRICES OF ANTIMONY have been reduced as from March 1. The new prices, with the previous prices in parentheses, per ton, delivered United Kingdom, are:—English, 99.6 per cent., £170 (£195); 99 per cent., £160 (£185); crude, 70 per cent., £130 (£150).

FAIRFIELD SHIPBUILDING & ENGINEERING COMPANY, LIMITED, Glasgow, have received an order for a 25,000-ton dw. ore carrier for the Liberian Navigation Corporation. The vessel, which will be Diesel driven, will be the largest ore carrier constructed in Britain.

MODERN MACHINE TOOLS, etc., will be offered at a Ministry of Supply auction sale to be held at Grand Hotel, Colmore Row, Birmingham, on March 28. Catalogues of the sale (price 6d.) may be obtained from the auctioneers, Edwards, Son, Bigwood & Mathews, 158, Edmund Street, Birmingham.

A. C. WICKMAN, LIMITED, of Tile Hill, Coventry, have been appointed the sole export agencies for A. W. Macnamara, Limited, Foundry Lane, Smetrwick, Birmingham, 40, and Hilmor, Limited, 65, Calshot Street, King's Cross, London, N.1, except in the latter case for South Africa, Holland, and Dutch East Indies.

VAUXHALL MOTORS, LIMITED, have installed at their Luton factory the largest scrap-metal baling press in the motor industry, at a cost of £28,000. It operates at a pressure of 2 tons per sq. in. Every month it converts over 1,300 tons of scrap sheet metal into compact bales. The new press was designed and built by the Loewy Engineering Company, Limited, Strand, London, W.C.2.

FOUNDRY SERVICES, LIMITED, of Long Acre, Nechells, Birmingham, 7, announce that, with effect from February 10, Mr. R. D. Hume and Mr. R. A. Miller are appointed joint general managers. Previously Mr. Miller was the technical manager and in charge of home sales and all technical problems. Mr. Hume was general works manager and also handled export sales. Under the new arrangement Mr. Hume will continue to handle the foundry problems of customers.

ADDRESSING Swansea Rotary Club recently on "Co-operative Research in the Iron and Steel Industry (with particular reference to local activities)," Mr. D. Luther Phillips, head of the British Iron and Steel Research Association at Swansea, said that in the past two years there had been turned out a perfect spate of new information which had been given to the industry practically as soon as it was found out. The industry had taken full advantage of what had been discovered to improve practice in works. He stressed that further advance in practice must be made if British iron and steel manufacturers were to maintain the pre-eminent position they had held and the need for scientists to play their part alongside industrialists, workers, and users of goods produced.

Pig-iron and Steel Production in Great Britain

Summary of December Statistics

The following particulars of pig-iron and steel production in Great Britain have been extracted from the Statistical Bulletin for January, 1950, issued by the British Iron and Steel Federation. Table I gives the production of pig-iron and ferro-alloys in December, 1949, with the number of furnaces in blast; Table II, production of steel ingots and castings in December, and Table III, deliveries of finished steel. Table IV summarises activities during the six months ended December, 1949.

TABLE I.—*Weekly Average Production of Pig-iron and Ferro-alloys during December*, 1949. (*Thousands of Tons.*)

District.	Furnaces in blast, 31.12.49	Hematite.	Basic.	Foundry.	Forge.	Ferro-alloys.	Total
Derby, Leics., Notts., Northants, and Essex	26	—	16.4	25.5	1.8	—	43.7
Lancs. (excl. N.W. Coast), Denbigh, Flints. and Cheshire; Yorkshire (incl. Sheffield, excl. N.E. Coast)	6	—	6.1	—	—	1.5	7.6
Lincolnshire	15	—	25.5	—	—	—	25.5
North-East Coast	23	7.9	35.5	0.4	—	1.4	45.2
Scotland	8	0.9	11.0	2.6	—	—	14.5
Staffs., Shrops., Worcs., and Warwick	9	—	8.9	1.4	—	—	10.3
S. Wales and Monmouthshire	8	4.2	19.2	—	—	—	23.4
North-West Coast	7	14.9	—	0.2	—	0.4	15.5
Total	102	27.9	122.6	30.1	1.8	3.3	185.7
November, 1949*	103	29.1	122.5	31.3	1.7	2.8	187.4
December, 1948*	102	24.9	117.2	28.9	1.8	3.1	176.0†

* Five weeks. † Incl. 100 tons of direct castings.

TABLE III.—*Weekly Average Deliveries of Non-alloy and Alloy Finished Steel.* (*Thousands of Tons.*)

Product.	1947 (53 weeks).	1948.	1948. Dec.*	1949. Nov.*	1949. Dec.
Non-alloy Steel:—					
Heavy rails and sleepers	7.6	8.9	8.4	11.9	10.5
Heavy and medium plates	31.6	36.1	38.5	41.4	40.4
Other heavy products	31.8	34.7	34.5	38.9	35.4
Light rolled products§	52.9	59.7	57.8	49.4	43.6
Hot rolled strip				17.5	18.2
Cold-rolled strip	4.6	4.8	4.7	5.4	4.6
Bright steel bars	4.8	6.1	6.0	5.9	5.6
Sheets, coated and uncoated	24.3	26.3	36.9	30.9	28.1
Tin, terne and blackplate	12.1	13.5	13.6	15.4	12.9
Tubes, pipes and fittings	13.5	15.1	15.9	20.1	19.3
Wire	10.8	12.8	13.7	16.1	14.6
Tyres, wheels and axles	3.5	3.9	4.0	4.4	3.7
Forgings	5.0	6.0	6.0	6.8	6.1
Castings	3.0	3.5	3.5	3.8	3.6
Total	205.5	231.4	233.5	267.9	246.6
Alloy Steel†:—					
Tubes and pipes	0.3	0.4	0.4	0.7	0.8
Bars, sheets, strip and wire	3.7	4.7	5.4	4.9	4.4
Forgings	1.8	2.5	2.8	3.0	2.7
Castings	0.6	0.7	0.7	0.8	0.7
Total	6.4	8.3	9.3	9.4	8.6
Total U.K. production‡	211.9	239.7	242.8	277.3	255.2
Less intra-industry conversion	19.2	29.3	32.3	34.3	27.1
Net U.K. deliveries	192.7	210.4	210.5	243.0	228.1
Add imported finished steel	2.2	3.4	5.6	2.3	4.8
Total deliveries of finished steel	194.9	213.8	216.1	245.3	232.9

† Excludes high-speed steel. ‡ Includes finished steel produced in the U.K. from imported ingots and semi-finished steel.
§ Excl. wire rods and alloy-steel bars, but incl. ferro-concrete bars

TABLE II.—*Weekly Average Production of Steel Ingots and Castings, December*, 1949. (*Thousands of Tons.*)

District.	Open-hearth. Acid.	Open-hearth. Basic.	Bessemer.	Electric.	All other.	Total. Ingots.	Total. Castings.	Total ingots and castings.
Derby, Leics., Notts., Northants and Essex	—	0.8	11.3(Basic)	1.0	0.2	12.7	0.6	13.3
Lancs. (excl. N.W. Coast), Denbigh, Flints. and Cheshire; Yorkshire (excl. N.E. Coast and Sheffield)	1.0	21.0	—	0.9	0.4	22.5	0.8	23.3
Lincolnshire	—	28.5	—	—	0.1	28.5	0·1	28.6
North-East Coast	1.5	62.4	—	0.7	0.4	63.6	1.4	65.0
Scotland	4.0	43.0	—	1.4	0.8	47.4	1.8	49.2
Staffs., Shrops., Worcs. and Warwick	—	11.4	—	0.6	0.5	11.5	1.0	12.5
S. Wales and Monmouthshire	9.4	42.2	5.9(Basic)	0.8	0.1	58.0	0.4	58.4
Sheffield (incl. small quantity in Manchester)	7.2	19.6	—	6.9	0.6	32.6	1.7	34.3
North-West Coast	0.5	1.9	4.3 (Acid)	—	0.1	6.6	0.2	6.8
Total	23.6	230.8	21.5	12.3	3.2	283.4	8.0	291.4
November, 1949*	25.3	251.4	20.3	14.1	3.5	305.5	9.1	314.6
December, 1948*	26.2	219.4	19.6	13.7	3.4	274.4	7.9	282.3

TABLE IV.—*General Summary of Pig-iron and Steel Production.* (*Weekly Average in Thousands of Tons.*)

Period.	Iron-ore output.	Imported ore consumed.	Coke receipts by blast-furnace owners.	Output of pig-iron and ferro-alloys.	Scrap used in steel-making.	Steel (incl. alloy). Imports.	Output of ingots and castings.	Deliveries of finished steel.	Stocks.‡
1938	228	89	—	130	118	16	200	—	—
1948	252	172	200	178	174	8	286	214	1,028
1949	258	169	199	183	188	17	299	231	1,275
1949—July	258	164	194	177	152	21	244	198	1,238
August*	248	172	196	182	179	21	288	205	1,320
September	266	177	199	185	194	19	306	239	1,331
October	237	178	196	184	194	12	307	242	1,296
November*	249	180	199	187	200	8	315	245	1,246§
December	249	170	197	186	181	12	291	233	1,275

* Five weeks. † Weekly average of calendar month. ‡ Stocks at end of years and months shown. § Revised.

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Designed to meet the demands of high quality castings, which are, strength, machineability and resistance to wear.

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The above illustration shows a group of castings made by Messrs. Goodbrand & Co. Ltd., Stalybridge, Cheshire.

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THE STANTON IRONWORKS COMPANY LIMITED NEAR NOTTINGHAM

Increases of Capital

Details of increased capital have been announced by the following companies:—

BROWNHILLS SMELTERS, LIMITED, Brownhills (Staffs), increased by £10,000, in £1 shares, beyond the registered capital of £20,000.

M.D.M., LIMITED, foundrymen, etc., of Smethwick, increased by £9,000, in £1 shares, beyond the registered capital of £6,000.

HELIPEBS, LIMITED, engineers, founders, etc., of Gloucester, increased by £40,000, in £1 shares, beyond the registered capital of £10,000.

WEISS & BIHELLER (METALS), LIMITED, Duke Street, London, S.W.1, increased by £4,000, in £1 shares, beyond the registered capital of £6,000.

EIFFEL FOUNDRY COMPANY, LIMITED, Walkden (Lancs), increased by £13,000, in £1 ordinary shares, beyond the registered capital of £2,000.

FEBANDSON, LIMITED, engineers, founders, etc., of Burnley, increased by £14,000, in £1 ordinary shares, beyond the registered capital of £14,000.

HALL & JUDD, LIMITED, engineers, founders, etc., of Hull (Yorks), increased by £3,500, in £1 ordinary shares, beyond the registered capital of £1,500.

JOHN W. LAYCOCK, LIMITED, iron merchants, etc., of Keighley (Yorks), increased by £5,000, in £1 ordinary shares, beyond the registered capital of £15,000

VAUGHAN LIFT ENGINEERS, LIMITED, Featherstone Street, London, E.C.1, increased by £4,700, in £1 ordinary shares, beyond the registered capital of £300.

J. & T. E. JENNENS, LIMITED, engineers' brassfounders, etc., of Hockley, Birmingham, increased by £4,000, in £1 ordinary shares, beyond the registered capital of £1,000.

L. WHITING, LIMITED, metal merchants, etc., of Cromwell Mews, London, S.W.17, increased by £4,000, in £1 ordinary shares, beyond the registered capital of £1,000.

C. C. BOGGIS, LIMITED, agricultural and general engineers, etc., of Wrentham (Suffolk), increased by £3,000, in £1 ordinary shares, beyond the registered capital of £2,000.

HENRY BARRETT & SONS, LIMITED, iron and steel merchants, etc., of Bradford, increased by £130,000, in £1 ordinary shares, beyond the registered capital of £70,000.

FLEMING & FERGUSON, LIMITED, marine engineers, etc., of Paisley, increased by £40,000, in 81,000 ordinary 10s. shares, beyond the registered reduced capital of £115,500.

SMITH WALLIS & COMPANY, LIMITED, founders, engineers, etc., of Sydenham Road, Birmingham, 11, increased by £37,000, in £1 ordinary shares, beyond the registered capital of £3,000.

TRANSPLANTERS (ROBOT), LIMITED, manufacturers of agricultural machines, etc., of Sandridge, near St. Albans, increased by £1,000, in £1 ordinary shares, beyond the registered capital of £15,000.

R. BLANDY & COMPANY, LIMITED, founders, engineers, etc., of Sands, High Wycombe, increased by £9,500, in 8,500 ordinary and 1,000 preference shares of £1 each, beyond the registered capital of £500.

J. W. JACKMAN & COMPANY, LIMITED, machinery merchants, etc., of Blackfriars Road, Manchester, increased by £50,000, in £1 preferred ordinary shares, beyond the registered capital of £30,000.

B. LEVY & COMPANY (PATTERNS), LIMITED, tool and pattern makers, etc., of Osbert Street, London, S.W.1, increased by £4,000, in 3,500 ordinary shares of £1 and 2,000 ordinary shares of 5s. each, beyond the registered capital of £1,000

DAVID BROWN TRACTORS, LIMITED (formerly Ferguson Brown, Limited), Meltham Mills, near Huddersfield, increased by £100,000, in 75,000 6 per cent. cumulative redeemable preference and 25,000 ordinary shares of £1 each, beyond the registered capital of £100,000.

Gazette

SULPHIDE CORPORATION, LIMITED, is being wound up voluntarily. Mr. J. S. Bowler, 37, Dover Street, London, W.1, is the liquidator.

A. & L. THOMAS ENGINEERS (BIRMINGHAM), LIMITED, is being wound up voluntarily. Mr. T. J. Prentice, 10-11, Queen's Road, Coventry, is the liquidator.

ANCASTER FOUNDRY, LIMITED, is being wound up voluntarily. Mr. E. W. Wentzell, Balfour House, 119-125, Finsbury Pavement, London, E.C.2, is the liquidator.

MR. B. PHILLIPS, 76, New Cavendish Street, London, W.1, has been appointed liquidator (with a committee of inspection) of Ian Metcalfe, Limited, ironfounders.

STEVENS SHANKS & SONS, LIMITED, typefounders, is being wound up voluntarily. Mr. R. S. Ford, Southampton House, 317, High Holborn, London, W.C.1, is the liquidator.

JAMES WILEY & SONS HOLDINGS, LIMITED, nut and bolt manufacturers, is being wound up voluntarily. Mr. G. Bendall, 95, Colmore Row, Birmingham, is the liquidator.

New Trade Marks

The following applications to register trade marks appear in the "Trade Marks Journal":—

"PAPERCOLL"—China clays. BECKER & COMPANY, LIMITED, 34-40, Ludgate Hill, London, E.C.4.

"VIPER"—Aircraft engines, etc. ARMSTRONG SIDDELEY MOTORS, LIMITED, Park Side, Coventry.

"PRINCESS" — Refrigerating apparatus. COLDAIR, LIMITED, Magnet House, Kingsway, London, W.C.2.

"FOUMEU"—Conveyors, etc. FOUNDRY MECHANISATIONS (BAILLOT), LIMITED, 19, Victoria Street, London, S.W.1.

"HOMA"—Metal casters and buffers. HOMA ENGINEERING COMPANY, Homa Works, Cambridge Road, Cosby (Leics).

"TWINNER"—Soldering and welding machines, and parts. DONALD ROSS & PARTNERS, LIMITED, 88, Regent Street, London, W.1.

"CHALLENGE"—Hand-operated and power-operated presses, etc. GEORGE INGRAM, 65-67, Edward Street, Birmingham, 1.

"CENTRIBLAST"—Shot-blast cleaning machines. SPENCER & HALSTEAD, LIMITED, Bridge Works, Wakefield Road, Ossett (Yorks).

"VISOMATIC" (DEVICE)—Indicating instruments for use in the control of heat, furnaces, etc. FREDERICK BURTON, 55, Millett Street, Bury.

"THE FIREBALL" (DEVICE)—Stoves, cookers, fireplaces, and boilers. SCOTTISH CENTRAL IRON COMPANY, LIMITED, Central Iron Works, Falkirk.

"OCEAN"—Gear boxes (parts of machines). ASSOCIATED BRITISH OIL ENGINES, LIMITED, Duke's Court, 32, Duke Street, St. James's, London, S.W.1.

"SLIX"—Mixtures of common metals and alloys with chemical compounds. FOUNDRY SERVICES, LIMITED, 285, Long Acre, Nechells, Birmingham, 7.

"MAXILITE"—Piston rings, engine pistons, valve tappets, and guides. BRITISH PISTON RING COMPANY, LIMITED, Brico Works, Holbrook Lane, Coventry.

"MAZDALLOY"—Common metal alloys (unwrought or partly wrought). BRITISH THOMSON-HOUSTON COMPANY, LIMITED, Crown House, Aldwych, London, W.C.2.

"VACROM"—Engine pistons and piston rings, cylinder liners, valve seatings, etc. HEPWORTH & GRANDAGE, LIMITED, St. John's Works, East Bowling, Bradford.

"VITACUT," "VITACARB" and "VITALUM"—Machines and parts included in Class 7. UNION ABRASIVES, LIMITED, Hemingfield, Carlton Road, Worksop.

"DURACRETE"—Refractory mixtures of silica, sand, and clay in powder or plastic form. KINGSCLIFFE SUPER-REFRACTORIES, LIMITED, Sandiron House, Beanchief, Sheffield, 8.

"POURFRACK," "PATCHFRACK," and "CEMFRACK"—Refractory material for lining furnaces, etc. NU-WAY HEATING PLANTS, LIMITED, 54, Gillhurst Road, Birmingham, 17.

"TUFTEX"—Unwrought and partly-wrought common metal alloys. R. H. MICHAULT and L. P. N. DODERO, c/o Abel & Imray, Quality House, Quality Court, Chancery Lane, London, W.C.2.

"PALATRUC"—Metal pallets (platforms for holding goods prior to their being loaded and transported) and stillages (supports). PALLETS, LIMITED, Imperial House, Dominion Street, London, E.C.2.

Contracts Open

The dates given are the latest on which tenders will be accepted. The addresses are those from which forms of tender may be obtained. Details of tenders with the reference E.P.D. or C.R.E. can be obtained from the Commercial Relations and Exports Department, Board of Trade, Thames House North, Millbank, London, S.W.1.

BALLYMENA, April 3—Provision and laying of about 2,750 yds. of 9-in. spun-iron pipes, etc., for the Borough Council. John Taylor & Sons, engineers, Artillery House, Artillery Row, Victoria Street, Westminster, London, S.W.1. (Fee £5, returnable.)

DEPWADE, March 27—Provision and laying of about 4 miles of 4-in. and 3-in. dia. spun-iron pipe mains, for the Rural District Council. A. P. I. Cotterell & Son, engineers, 54, Victoria Street, Westminster, London, S.W.1. (Fee £2 2s., returnable.)

HEMEL HEMPSTEAD, March 20—Castings, bib taps and ball valves, stop-cocks and ferrules, cast-iron pipes and specials, sluice valves, wrought-iron pipes and fittings, etc., for the Borough Council. Mr. A. H. Turner, borough engineer, Market Square, Hemel Hempstead (Herts).

LOUTH—Supplying and laying about 2,800 yds. of 3-in. spun-iron mains, etc., for the Rural District Council. Mr. J. H. Haiste, consulting engineer, 4, Queen Square, Woodhouse Lane, Leeds, 2. (Fee £3 3s., returnable.)

MIDDLESBROUGH, March 21—Spun-iron concrete-lined pipes, cast-iron specials, cast-iron surface boxes, engineering bricks, etc., for the Tees Valley Water Board. Mr. E. A. Morris, clerk of the Board, Water Board Offices, Corporation Road, Middlesbrough.

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Raw Material Markets

Iron and Steel

Foundries generally are fairly well employed, although the light foundries could undertake additional work. Consequently, the call for their grade of iron in the high-phosphorus type, mostly from the Northants area, has shown some relaxation. The demand for other grades of pig-iron is maintained. Foundries producing castings for the general engineering and textile trades are absorbing the output of the high-phosphorus irons from the Derbyshire area, production of which is expected to show an increase when the new furnace, now in course of construction, is blown in.

Low- and medium-phosphorus irons are in strong demand and current supplies are insufficient. In fact, the stringency is such that any reduction on present outputs due to furnace troubles or other causes would have serious repercussions at the foundries. This shortage is resulting in a larger demand for hematite, which so far has been satisfied. There is a better call, too, for the refined grades, but outputs are sufficient to meet the home demand and also to provide consignments for shipment abroad.

Foundry coke is coming forward in scheduled quantities; many of the coke ovens, however, are fully committed for their outputs and cannot accommodate additional orders. Some difficulty has been experienced by users recently in obtaining furnace coke on account of the priority given to export orders. Satisfactory quantities of ganister, limestone, ferro-alloys, and firebricks continue to be delivered.

Indicative of the transformation in the relationship of supply and demand in the semi-finished steel trade is the sharp contraction in the volume of imports. Acceptances from overseas are reduced to little more than 50 per cent. of the corresponding figures for last year and, although home producers are clearing their outputs of billets, blooms, and sheet bars, there is little interest in defectives, crops, etc.

Prolongation of the American coal strike is beginning to exercise a serious effect on operations in the US steel plants, and unless a settlement is speedily achieved, the further diversion of orders to this country may be expected. Rollers are already busily engaged on overseas contracts chiefly for destinations within the Commonwealth. These embrace a wide range of products, such as rails, plates, sheets, heavy sections, and wrought-iron pipes. The plate mills have more specifications than they can complete before the end of the current period, and if new business in joists and sections is inclined to sag, the mills have a substantial volume of work in hand. Trade in small and medium sizes is very quiet.

Non-ferrous Metals

Tin made a poor start last week, but subsequently improved and on Friday afternoon a very active session took place, some 400 tons changing hands for the prompt position. This unwonted activity not unnaturally aroused a good deal of comment for it was quite foreign to the somewhat lifeless tempo of trading during the preceding day.

Metal Exchange tin quotations were as follow:—*Cash*—Thursday, £599 15s. to £600; Friday, £599 15s. to £600; Monday, £599 15s. to £600; Tuesday, £599 10s. to £600; Wednesday, £599 to £599 10s. *Three Months*—Thursday, £586 to £586 5s.; Friday, £585 10s. to £586; Monday, £588 to £588 10s.; Tuesday, £587 15s. to £588 5s.; Wednesday, £589 to £589 10s.

In the other metals demand is a trifle subdued, for at the inflated price ruling for copper consumers are showing caution; in zinc and lead, particularly the latter, the likelihood of a break in price checks buying. Nevertheless, consumption of lead during January, according to figures issued by the Bureau of Non-ferrous Metal Statistics, was well up to average at 27,940 tons and, in fact, was an increase of 1,200 tons on the December total. In zinc, consumption during January amounted to 27,264 tons, against 25,737 tons in December, while the stocks of 61,570 tons at the end of last year were reduced to 54,145 tons at January 31. The copper figures show that consumption in January was 25,086 tons of virgin copper and 16,887 tons of secondary metal. In December the corresponding figures were 24,325 tons and 14,517 tons. As to stocks, the blister tonnage of 46,796 at December 31 declined to 40,402 tons at the end of January, but there was an increase in reserves of refined copper from 82,878 tons at the end of 1949 to 89,798 tons at January 31.

Dealings in scrap, both brass and copper, are fairly brisk and price changes, if any, are upwards. Extrusion metal remains decidedly scarce and the release of Government stocks of secondary brass suitable for the manufacture of extrusion billets would be welcomed. Brass swarf is far from plentiful and the price is firm at approximately £80 per ton. Confirmation that the Government's surplus accumulations will be put out to tender in the normal manner, and not sold in bulk as suggested earlier, is lacking, but nevertheless there is a widespread belief that the former course will be adopted. The main point appears to be a rapid clearance of mixed parcels which require to be sorted before the metal can be used to the best advantage.

Company Results

(Figures for previous year in brackets.)

PARSONS ENGINEERING COMPANY—Trading loss to October 31, 1949, £10,961 (£10,443); net loss, after depreciation, etc., £25,337 (£14,849), increasing debit forward to £33,715 (£8,378).

R. & W. HAWTHORN, LESLIE & COMPANY—Interim dividend of 4% (5%) on £895,688 (£537,413) capital. The directors state that the increased interim payment is not to be regarded as an indication that the total for the year will be increased.

D. NAPIER & SON—Balance on trading account for the receipts for 1949, £1,253,565 (£1,032,214); net profit, after depreciation, other than land, and tax, £55,343 (£53,890); dividend of 7½% (same); general reserve, £150,000 (nil); forward, £122,602 (£260,164).

LE GRAND, SUTCLIFF & GELL—Trading profit for the year to September 30, 1949, £56,006 (£30,886); net profit, after depreciation, tax, etc., £18,254 (£14,074); to preference dividend, £3,128 (£2,079); ordinary dividend of 12½% on increased capital (same), £6,875 (£4,616); to writing down value of Rochester Development account, £3,000 (nil); general reserve, £4,000 (£3,000); forward, £15,740 (£14,219).

BLYTHE COLOUR WORKS—Trading profit for 1949, £210,906 (£183,163); net profit, after tax, depreciation, etc., £86,840 (£73,906, plus £3,000 surplus tax provisions from past years); to general reserve, £46,825 (£40,000); costs of bonus share issue, £572 (nil); final dividend of 20% and bonus of 20%, making 60% on capital increased by 50% bonus issue (final dividend of 30% and bonus of 30%, making 80%); forward, £22,433 (£19,290).

SAMUEL OSBORNE & COMPANY—Consolidated trading balance for the year to July 31, 1949, £436,243 (£537,166); net profit, after depreciation, tax, etc., £153,262 (£255,806); to pensions reserve, £30,000 (nil); dividend equalisation reserve, £55,000 (nil); interim dividend of £% (2½%) and second interim dividend of 10% (final dividend of 12½%); forward, £593,939 (£496,984), of which £139,497 retained in subsidiaries, and £454,442 by parent company. The report states that no final dividend is recommended, having regard to the directors' agreement to dividend limitation.